September 14, 1933

SEP 16 1933

Engineering News-Record

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Advanced Waterworks Practices

The virtual certainty of greatly increased activity in improving water supplies makes it more imperative than ever for the waterworks engineer to be fully informed in the modern technique of his art. To signalize the meeting during the coming week of the New England Water Works Association, this issue presents a group of technical articles reporting some of the most recent advances in waterworks design, construction and operation.

The New Water Supply for Metropolitan Boston

Well-Managed Tunneling Whips Low-Contract Price

Ammonia-Chlorine Treatment Causes Nitrite Troubles

Unique Filter Bottom in New Water Plant

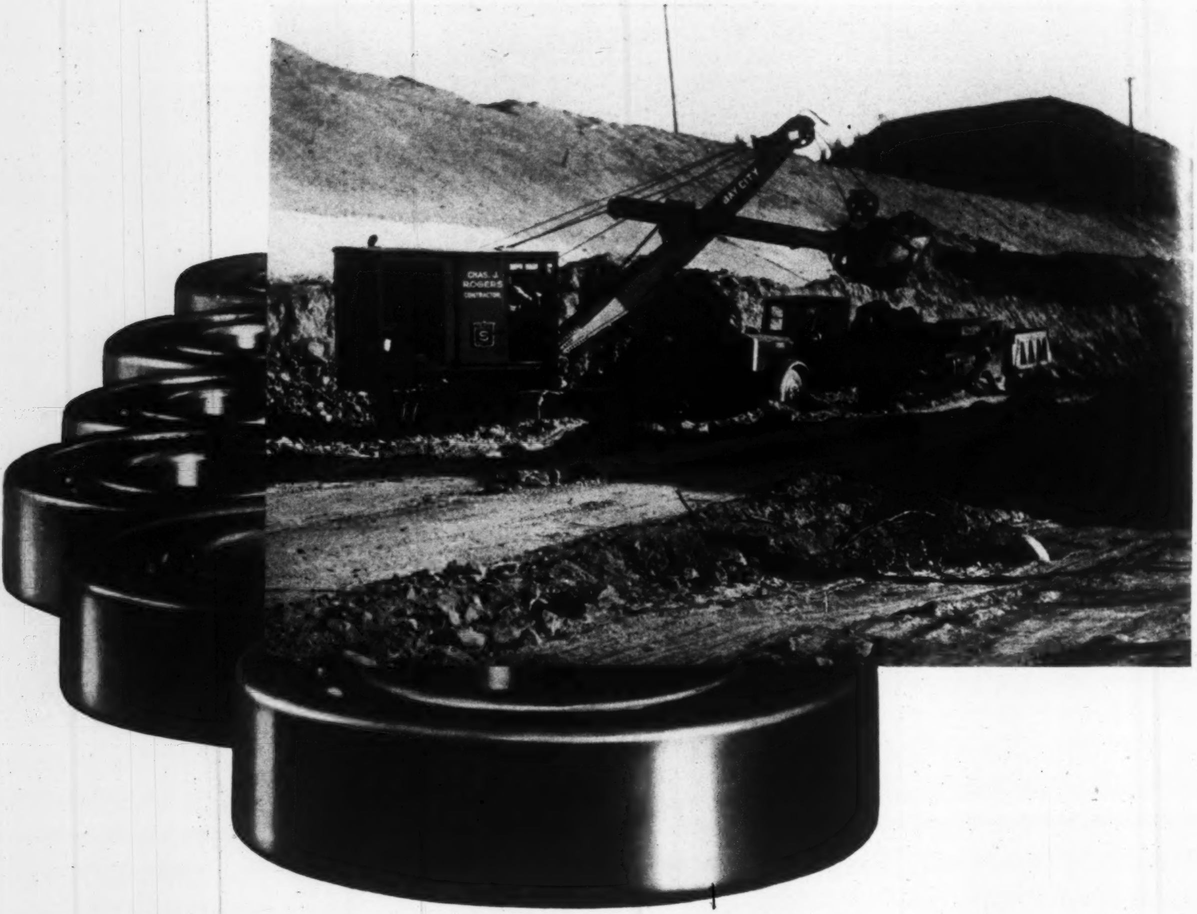
Storage-Tank Operation to Aid Pressure Conditions

. . . ALSO . . .

Willamette Valley Sanitary Program

Enlarged Highway System for California

Answers to PWA Loan Questions



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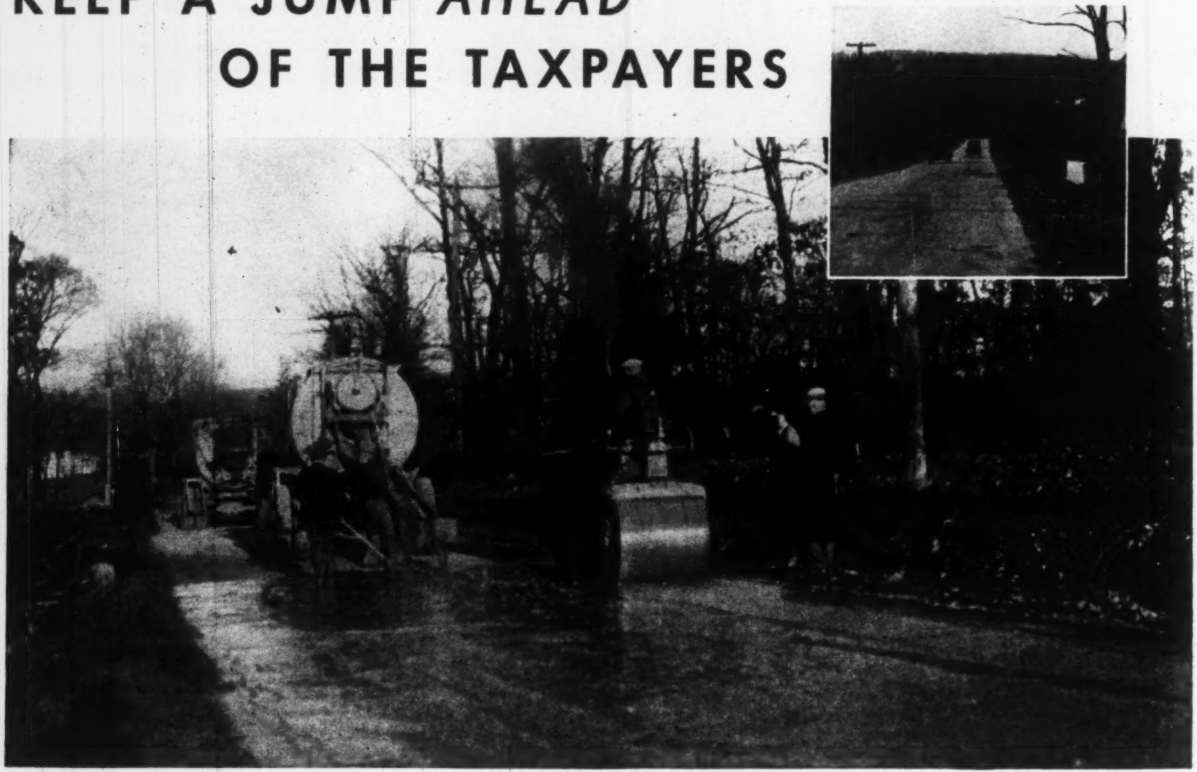

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Advance in Waterworks Practice

RENEWED activity in the building of improvements for the waterworks systems of our cities is to be witnessed within the next few months. Not only is there widespread recognition of the need for such improvements but the declared policy of the Public Works Administration in passing upon applications for loans for the construction of local improvements under the terms of the NIRA is to give a preferred place to water supply projects. Thus the outlook is bright for remedying many of the waterworks deficiencies that exist throughout the land.

And these deficiencies are numerous indeed, as all waterworks men know. Though the motive for undertaking such work at this time is, to a large extent, to create employment and to deliver an upward push to our uncertainly rising curve of business activity, the waterworks engineer has the great responsibility of making sure that the communities taking part in the program get the fullest value possible from every dollar expended. It is a serious responsibility, for upon such an outcome depends the repute not only of engineers as a class but also of the efficacy of public works construction as an economic stimulant.

ESPECIALLY at this time, therefore, it is highly essential that engineers be fully informed as to the latest advances in the art and science of water supply. Only in this way can they be confident that the expenditures to be entrusted to their administration will yield the greatest possible value to the public. To be of aid in this endeavor the present number of *Engineering News-Record,* its publication date approximating that of the annual meeting of the New England Water Works Association, includes a group of articles reporting the latest additions to the knowledge of the design, construction, operation and maintenance of water supply systems.

In New England itself the largest water supply project under way is for Metropolitan Boston, a major element of which is the long concrete-lined tunnel being driven to tap the new Quabbin Reservoir. Much can be learned from the description given in the following pages of the advanced construction methods used by the contractor. He was faced at the outset of his job by the handicap of an unusually low contract price; the application of ingenuity combined with good management has served to place the job well on the way towards successful completion.

THE design of the filter plant for the Mahoning Valley Sanitary District involves at least one feature of unusual interest in the use of a false filter bottom in conjunction with the Wheeler system of wash water distribution. Here is a case where an old element of design, which had largely fallen into disuse in recent years, has been modernized by a simple expedient, with a resulting increase in economy of construction and facility of operation.

Within the past few years the use of ammonia in combination with chlorine has found wide application in water sterilization. Its great advantage is that it prevents the formation of evil-tasting chloro-phenol compounds. Observations at Detroit, however, reported in the following pages, revealed the formation of nitrite compounds in the filter effluent, with a consequent waste of chlorine, impaired sterilization and uncertain determination of chlorine residual. Such disadvantages in a highly useful process should make experiments at other places desirable and remedial measures urgent.

Of considerable value is the report of the effects on distribution pressures of elevated storage in Milwaukee. High peak demands during the afternoon hours in this city formerly reduced pressures to the vanishing point in certain areas. This condition is now being economically remedied by distribution storage that is filled during the night and pours its contents into the distribution system just as the demand for water for lawn sprinkling starts to mount.

ALL of these articles present subject matter that is highly appropriate to the needs of the times. In addition to being instructive in themselves, they reflect the ability and resourcefuness of water supply engineers and contractors. These personal characteristics will be as important to the success of new water supply projects as is the financial help that the PWA is extending. They should be fostered and developed if water supply practice is to continue to advance.

Progress on the New Water Supply for Metropolitan Boston

Development by Metropolitan District Water Supply Commission includes 24.6-mile aqueduct tunnel, diversion bore and two large earth dams with pneumatic-caisson corewalls—Project taps Ware and Swift Rivers in central Massachusetts

IN THE QUEST for a new and adequate water supply to serve a population of 2,000,000, Metropolitan Boston has turned to the hills of central Massachusetts, 50 to 70 miles away, where the Ware and Swift Rivers are being tapped to furnish an additional net yield of 194 m.g.d., more than doubling the present supply. The new development, the largest in the East outside of New York City, includes a 11x12.75-ft. tunnel, known as Quabbin Aqueduct, extending 24.6 miles westward from the present Wachusett Reservoir; a diversion dam and elaborate intake works on the Ware River, 14 miles from Wachusett; intake control works at the west portal; two large earth dams on Swift River and Beaver Brook, which will form the new Quabbin Reservoir; and a large diversion tunnel at the Swift River Dam. A feature of each of the earth dams, to be founded on glacial drift, is a pneumatic-caisson corewall extending across the valley to seal off the pervious underlying strata.

The Metropolitan Water District was established in 1895. It included the cities of Boston, Chelsea, Everett, Malden, Medford, Newton and Somerville, and the towns of Belmont, Hyde Park (now a part of Boston), Melrose, Revere, Watertown and Winthrop. Under the law creating the district, which provided that any municipality within 10 miles of the State House might join, Quincy, Arlington, Brookline, Lexington, Milton, Nahant, Stoneham and Swampscott have become a part of the district. These twenty municipalities now have a combined population of 1,500,000. There are fifteen more towns with a combined population of 400,000 eligible to join the district at any time. The metropolitan water system, completed 25 years ago with the exception of additional mains as required, includes Cochituate Lake and Aqueduct (1848), the Sudbury Aqueduct and eight storage reservoirs (1872-'99), Wachusett Reservoir and the Weston and Wachusett aqueducts (1895-1906), equalizing reservoirs at Chestnut Hill (1868), Spot Pond (1900), Weston (1905), and various standpipes and distribution mains now totaling 175 miles in length.

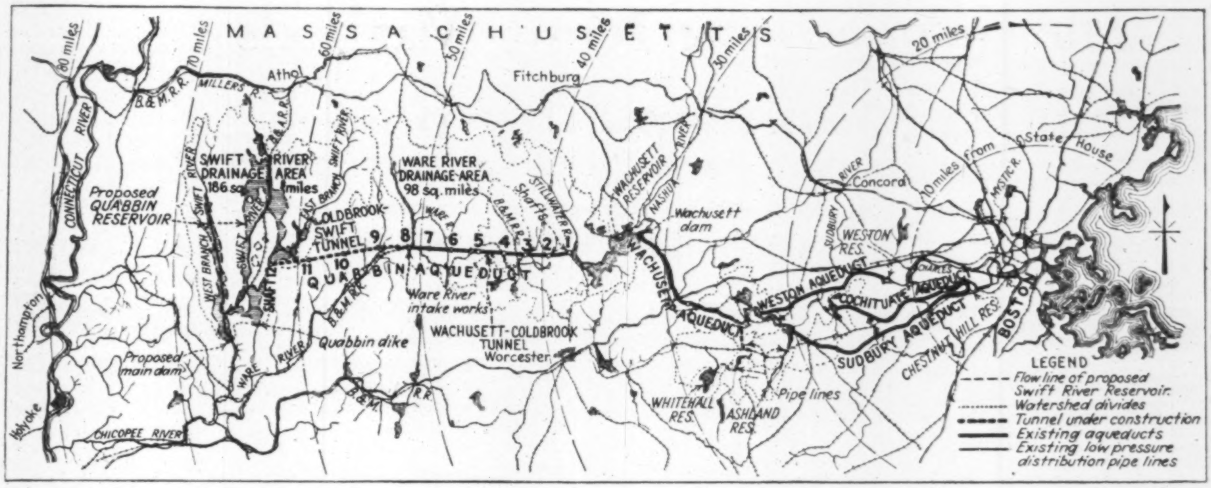
The need of additional water supply became evident fifteen years ago. Investigations of two commissions reporting in 1922 and 1926 led to legislation in 1927, which created the Metropolitan District Water Supply Commission, with authority to construct new works and turn them over to the Metropolitan District Commission for operation when completed. Legislation made provision for emergency use of certain waters of the Sudbury system, which had been little used; for the diversion of floodwaters of the Ware River and for the use of the greater part of the waters of the Swift River, to be accomplished by construction of the Quabbin Reservoir. The Ware River above the diversion dam has a drainage area of 98 square miles and will furnish a net yield of 40 m.g.d. The Swift River drainage area, 186 square miles, will supply a net yield of 154 m.g.d. The district requires 140 m.g.d., with an additional 30 m.g.d. requirement for the fifteen towns not yet in the district.

Start of a new water-supply development for Metropolitan Boston. First blast fired on the first section of Quabbin Aqueduct by J. J. Coughlan & Sons, Inc., contractor.

Interstate litigation

In January, 1928, Connecticut filed a bill of complaint in the U. S. Supreme Court seeking to enjoin Massachusetts from diverting any waters from the Connecticut River watershed. The Ware and Swift Rivers flow into the Connecticut through the Chicopee. Three years later the court sustained the rights of Massachusetts to these waters, subject to regulation by the War Department. This department has ruled that no diversion of Ware River waters shall be made between July 15 and Oct. 15. Regulation of the Swift River provides that sufficient waters must be released from the Quabbin Reservoir to maintain a flow of 20 m.g.d. at Bondsville, just below the main dam, and that there be released from the reservoir during the period from June 1 to Nov. 1 of each year 110-sec.-ft. when the flow of the Connecticut at Sunderland is less than 4,650 sec.-ft. and 70 sec.-ft. when the Connecticut flow is between 4,650 and 4,900 sec.-ft. The net yields of the new development, previously mentioned, take into account the regulative restrictions.

The diversion works at the Ware River and the 14-mile section of the aqueduct tunnel to Wachusett Reservoir from the Ware have been completed and were placed in operation in March, 1931. Driving of the tunnel was described in *ENR*, Sept. 11, 1930, p. 420. The tunnel was driven from eight shafts, No. 1 containing the outlet control works of Wachusett Reservoir and No. 8 being the intake at Ware River. The flow line of the Wachusett Reservoir is 261 ft. lower than the Ware River intake and 135 ft. lower than the proposed flow line of Quabbin Reservoir. This per-


MASSACHUSETTS
80 miles
70 miles
60 miles
50 miles
40 miles
30 miles
20 miles
10 miles from State House
Athol
Fitchburg
Concord
Boston
Northampton
Holyoke
Worcester
CONNECTICUT RIVER
B.&M.R.R.
MILLERS R.
B.&A.R.R.
SWIFT RIVER DRAINAGE AREA 186 sq. miles
WARE RIVER DRAINAGE AREA 98 sq. miles
Proposed QUABBIN RESERVOIR
COLDBROOK-SWIFT TUNNEL
9 8 7 6 5 4 3 2 1
11 10
SHAFT 12
QUABBIN AQUEDUCT
Ware River intake works
Quabbin dike
WACHUSETT-COLDBROOK TUNNEL
Proposed main dam
WARE RIVER
CHICOPEE RIVER
WEST BRANCH
EAST BRANCH
SWIFT RIVER
Shafts
STILLWATER R.
WACHUSETT RESERVOIR
NASHUA RIVER
Wachusett dam
WACHUSETT AQUEDUCT
WESTON AQUEDUCT
WESTON RES.
COCHITUATE AQUEDUCT
SUDBURY AQUEDUCT
SUDBURY RIVER
MYSTIC R.
CHESTNUT HILL RES.
WHITEHALL RES.
ASHLAND RES.
Pipe lines
LEGEND
Flow line of proposed Swift River Reservoir
Watershed divides
Tunnel under construction
Existing aqueducts
Existing low pressure distribution pipe lines

Map of new water-supply development for Metropolitan Boston, showing location of Quabbin Aqueduct and two earth dams that will form Quabbin Reservoir, also location of existing works.

mits waters from the Ware to be diverted to either of the reservoirs for storage.

The Ware intake works are unusual. The diversion dam is a masonry gravity-section arch, designed as a full spillway. Diversion is accomplished by nine siphon spillways with crests 1 ft. lower than the spillway of the dam. These siphons discharge into a central pit, in which the water level is controlled by four butterfly valves set directly over the intake shaft. These valves automatically control the rate of diversion and also create a water seal to prevent entrance of air into the tunnel. The operation is entirely automatic, designed to divert all floodflows in excess of 85 m.g.d. into the shaft, and to prevent any diversion when the river flow is less than this limiting rate. From each valve the water enters the shaft through a nozzle set at an angle with the shaft wall. The entire shaft is lined with cast-iron plates with helical vanes, which give the falling waters a swirling motion to dispel the energy of the fall. Venturi meters and recording devices are located in the valve house at the top of the shaft. The final design of the shaft was, in part, based on tests of a model built at Worcester Polytechnic Institute.

The second section of the aqueduct tunnel, from the Ware River westward to Quabbin Reservoir, is now under construction. It is described in the article following this one. Under the first tunnel contract the bore was extended 5 000 ft. westward from shaft 8. Near this point a steel bulkhead was installed, fitted with two hinged doors, opening toward shaft 8. These doors act as check valves, preventing waters of the Ware River intake from flowing toward Quabbin Reservoir; but they will permit a flow from the reservoir eastward into the Wachusett Reservoir in case of emergency if such a flow is needed before the Quabbin Reservoir is ready to store water. To prevent an excessively high head in the aqueduct under flood conditions, with the outlet gates at Wachusett closed, shaft 2 of the first tunnel section has been equipped as a spillway.

Until the Quabbin reservoir is completed, the diversions from the Ware will flow directly by gravity into Wachusett Reservoir, being controlled only by the gates at the Ware River intake. After the Quabbin Reservoir is put in service, flow into the Wachusett Reservoir will be controlled at the tunnel outlet at Shaft 1. No control works will be installed at the intake at Quabbin Reservoir, allowing a free flow of Ware River diversion into the reservoir, or a free flow from the lake into the tunnel. The outlet control works at Shaft 1 are all located within the shaft and in the gate house set over the shaft. The waterway up the shaft is lined for the top 95 ft. with steel pipe to prevent uplift pressures from disturbing the shaft structures. A vertical venturi meter was installed in the waterway. A 20-in. single-stage centrifugal pump has been installed in a separate riser at the foot of the shaft for unwatering the tunnel. The 900-hp. motor for this pump is kept at the surface except when in use.

Quabbin Reservoir

The creation of Quabbin Reservoir, the main storage of the new development, involves the building of two large earth dams. Several villages, including the town of Enfield, will be drowned out by the new lake. Miles of highways are being relocated at the present time. Construction of the pneumatic-caisson corewall for one of the dams, Quabbin Dike on Beaver Brook, is now under way (*ENR*, Aug. 24, 1933, p. 215). Contract for the earthfill at this dam has not been let. Quabbin reservoir will have a capacity of 415 billion gal.

At the main dam on Swift River actual construction has been confined to driving of a diversion tunnel and building of earth cofferdams (*ENR*, July 28, 1932, p. 107), and the sinking of an exploratory caisson along the dam corewall. Pumps have been installed in this caisson to lower the groundwater level.

Further work on the main dam is being delayed pending decision as to the disposition of a branch line of the B.&A. Railroad along the river.

Organization

Design and construction of the new water supply is under the direction of Frank W. Winsor, chief engineer of the Metropolitan District Water Supply Commission. Karl R. Kennison is designing engineer. Construction of the project is under the supervision of three division engineers, William W. Peabody, Richard R. Bradbury and N. LeRoy Hammond. X. Henry Goodnough, J. Waldo Smith and Charles T. Main are consulting engineers for the commission.

Construction for main parts of the work were and are as follows: shafts 2, 3 and 4, Dravo Contracting Co., Pittsburgh; shafts 5, 6 and 7, J. J. Coughlan & Sons, Inc., Boston; shafts 1 and 8, and first or Wachusett-Coldbrook section of aqueduct tunnel, J. P. Porter & Sons, Portand, Ore., and J. J. Coughlan & Sons, Inc., both assigning their contracts to the West Construction Co. of Boston; sinking of exploratory caissons at both dams, Dravo Contracting Co.; diversion tunnel at Swift River Dam, Northern States Contracting Co., St. Paul; pneumatic caissons for Quabbin Dike corewall, West Construction Co., Boston; shafts 9, 10, 11 and 12 and Coldbrook-Swift extension of aqueduct tunnel, Wenzel & Henoch Construction Co., Milwaukee, Wis.

Well-Managed Tunneling Methods Whip Low Contract Price

Last section of tunnel aqueduct for Boston Metropolitan District water supply being completed at rapid pace and low cost by well-organized methods and plant

EXTENSION of the aqueduct to the new Ware and Swift River water supply (Quabbing Reservoir) for the Metropolitan District of Boston is being completed by the rapid driving of a 10.6-mile tunnel. This tunnel work, contracted at an exceptionally low price, has developed plant design and methods of procedure that have given praiseworthy results in speed and economy. Briefly noted these are: (1) accident prevention; (2) an improved mucking machine; (3) hoisting the muck in skips instead of in the muck cars; (4) dumping skips directly to shaft-top primary crushers, feeding belt conveyor to stock piles; (5) a full-round drill carriage; (6) traveling forms and concreting plant for lining; and (7) a complete machine shop on the surface and supplementary repair shops in the tunnel. Each of these factors in the fast progress of the work will be considered in its place in the following description of the tunneling operations.

The place of the new aqueduct in the system of aqueducts which delivers water to the Metropolitan District of Boston is indicated by the map in the preceding article. The Quabbin reservoir, formed by two large earth dams, will impound restricted amounts of the flow of the Ware and the Swift Rivers, tributaries of the Connecticut River, about 50 and 65 miles west of Boston. From Quabbin Reservoir the new aqueduct extends to the Wachusett Reservoir about 40 miles west of Boston. It is entirely in tunnel 24.6 miles long. The first section of the tunnel, to Ware River (14 miles), where a diversion dam and control works were constructed, is now in service. This tunneling operation was described in *Engineering News-Record*, Sept. 11, 1930, p. 420. The second section of tunnel, 10.6 miles long, continues the aqueduct to an intake in Quabbin Reservoir on the Swift River. This 10.6-miles tunnel is the subject of the present article. Other parts of the work have been described in *Engineering News-Record*, July 28, 1932, p. 107, and Aug. 24, 1933, p. 215. The contracts have not been awarded for the main dam for the Quabbin Reservoir or for the earthwork of the supplementary Quabbin Dike.

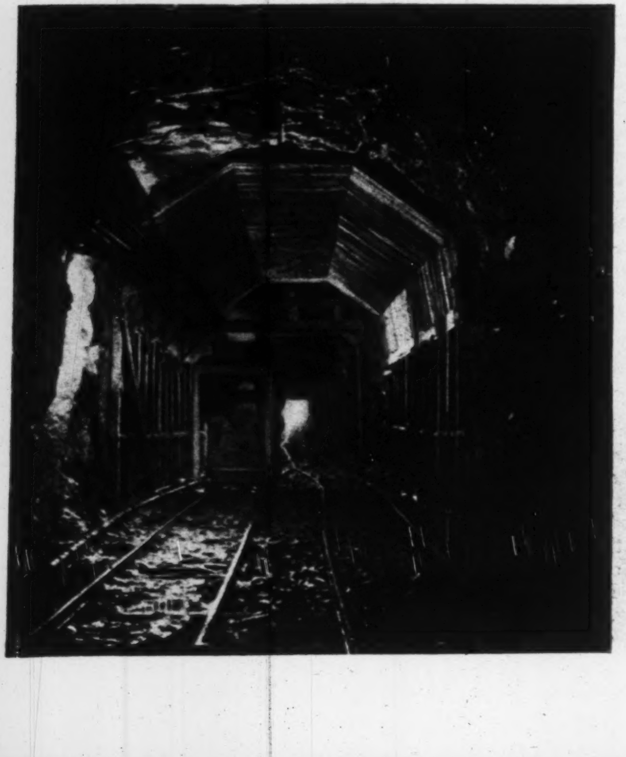


Fig. 1—Clean, well-lighted and neatly timbered workings characterize construction of final 10.6-mile section of 24.6-mile tunnel aqueduct for Boston Metropolitan District water supply from Quabbin Reservoir.

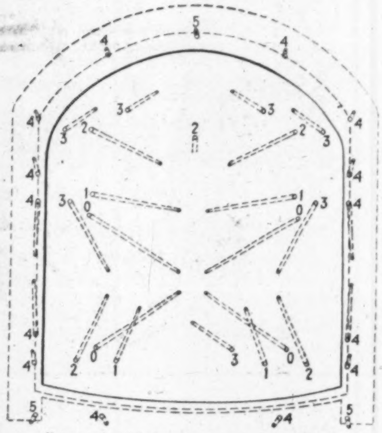


Fig. 2—General drilling and blasting diagram for full-section heading of final section of Quabbin tunnel aqueduct.

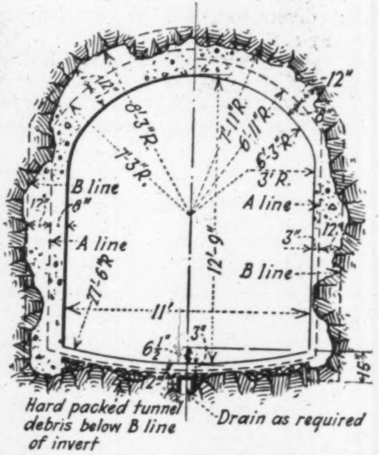


Fig. 3—Maximum and minimum sections of rock bore and concrete lining for final section of Quabbin tunnel aqueduct.

The tunnel, as shown in section by Fig. 3, is being constructed from four shafts, the last shaft being near enough to the tunnel inlet to make driving from the shaft more economical than to install a separate plant for a portal heading. The shaft nearest the Quabbin Reservoir end is only 90 ft. deep, but the others are quite deep, 200, 408 and 275 ft. All shafts are lined with concrete 2 ft. thick in earth and a minimum of 3 in. in rock. The greatest depth of earth at any shaft is 34 ft. All are circular and 14 ft. in diameter.

The tunnel-lining details are sufficiently indicated by Fig. 3. Except for two angles one of 2 deg. and one of 12 deg., the alignment of the tunnel is straight. Its grade is in alternate level and slightly downgrade sections from west to east.

Construction plan

The controlling factor in planning construction was the contract price. Neither the materials penetrated nor water conditions offered unusual difficulties. The specified contract time did not crowd the contractor. The contractor's price for the tunnel was $4,917,032, which was nearly $1,000,000 less than the second bid. The construction problem for the contractor was to meet this low price not only throughout the spread of the work but in detail. For example, the price for excavation

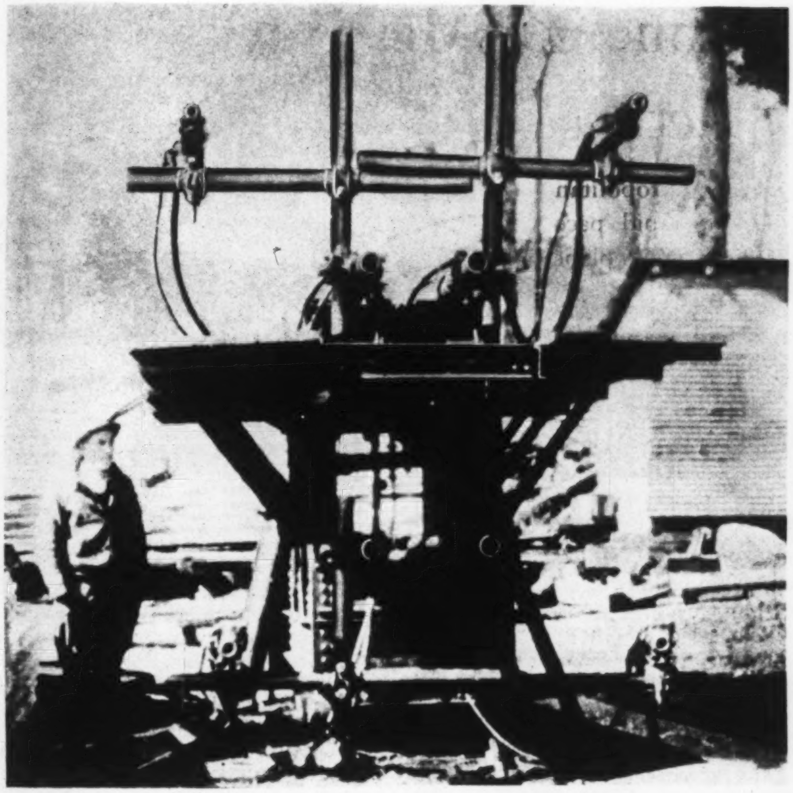


Fig. 4—Drill carriage, with folding side platforms and drill columns, for drilling full-section heading on final section of Quabbin tunnel aqueduct.

was $8.80 a cubic yard, and for lining it was $3 a cubic yard for concrete, plus a price for forms and drainage and cement paid for by the commission at $2.15 per bbl.

The planning of the work from the beginning was directed to whipping the low prices. In doing this, the contractor was aided by a break in materials prices, but chiefly success was due to close coordination and ingenious methods. As enumerated in the opening paragraph, these factors divide into those directly affecting (1) excavation, (2) concrete lining, and (3) those serving both excavation and lining, such as safety measures and machine-shop service.

Excavation

Incidentally, shaft-sinking developed no unusual methods; shafts were drilled and then blasted half at a time, and the excavated material was hoisted by cranes until the shaft was completed and sufficient tunnel driven to warrant installation of the permanent-shaft headframes. The rock in the shafts as well as that in the tunnel was a compact schist and granite.

In the tunnel the full-face headings were driven both ways from each shaft. The normal drilling round is shown by Fig. 2, the numerals on the holes indicating the delay sequence in firing the blast. All drilling was done from a carriage traveling on a 36-in.-gage track. This machine, as shown in Fig. 4, was constructed in the contractors' shop and was one of the factors that reduced cost and speeded excavation. It consisted of a structural-steel frame and wood deck on wheels, having on each side a wood platform that folded down against the sides of the frame when the carriage was moved. The upper part of the frame carried two columns, which also could be folded back flat on the top of the frame, and on each of which were two arms for drills. On the lower part of the frame were two shorter columns, which carried a cross-bar for drills; this cross-bar also could be folded against the side when not in use. Usually four drifter drills were used, two on the upper columns and two on the cross-bar, but at times another drill was added to each pair. The folding platforms were used for stocking the drill steel for the upper pair; that for the lower pair was stocked on the tunnel floor alongside the carriage. Contributing to time-saving in handling the drill steel was a special car by which the steel was brought into the heading, racked according to length. To speed drill repairs, a small repair shop was installed at the bottom of each shaft; the main machine shop was available for major repairs.

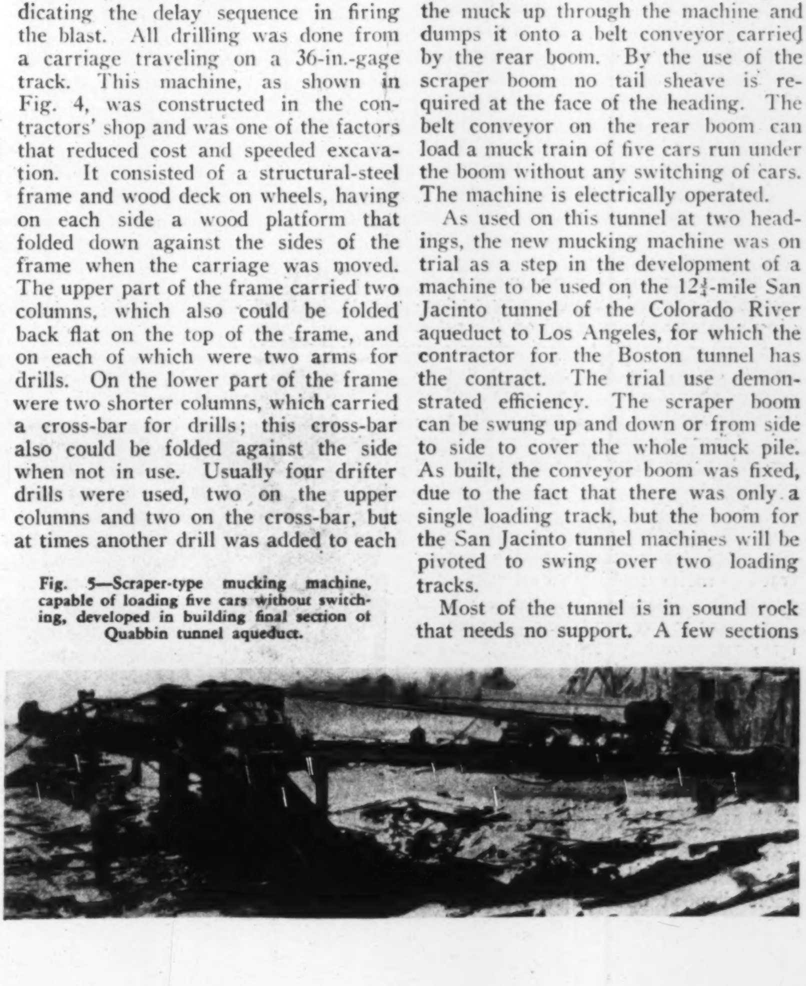


Fig. 5—Scraper-type mucking machine, capable of loading five cars without switching, developed in building final section of Quabbin tunnel aqueduct.

A drill carriage was used in each heading. A heading was drilled, and then the crew moved to the drill carriage at the other heading. This shift was not always possible, but often a heading was drilled, blasted and mucked out in a ten-hour shift. The mucking crews, like the drillers shifted between headings.

In all headings but those from one shaft, standard mucking machines were used, as they were included in the plant bought from the contractor who built the first section to the Ware River of the 24-mile conduit (*ENR*, Sept. 11, 1930). At one shaft the mucking machine shown by Fig. 5 was used. This machine was designed by the contractor and was built in his shops. The machine, traveling on rails, carries long booms extending ahead and back from the carriage. The forward boom carries a slackline cableway excavator that pulls the muck up through the machine and dumps it onto a belt conveyor carried by the rear boom. By the use of the scraper boom no tail sheave is required at the face of the heading. The belt conveyor on the rear boom can load a muck train of five cars run under the boom without any switching of cars. The machine is electrically operated.

As used on this tunnel at two headings, the new mucking machine was on trial as a step in the development of a machine to be used on the 12¼-mile San Jacinto tunnel of the Colorado River aqueduct to Los Angeles, for which the contractor for the Boston tunnel has the contract. The trial use demonstrated efficiency. The scraper boom can be swung up and down or from side to side to cover the whole muck pile. As built, the conveyor boom was fixed, due to the fact that there was only a single loading track, but the boom for the San Jacinto tunnel machines will be pivoted to swing over two loading tracks.

Most of the tunnel is in sound rock that needs no support. A few sections

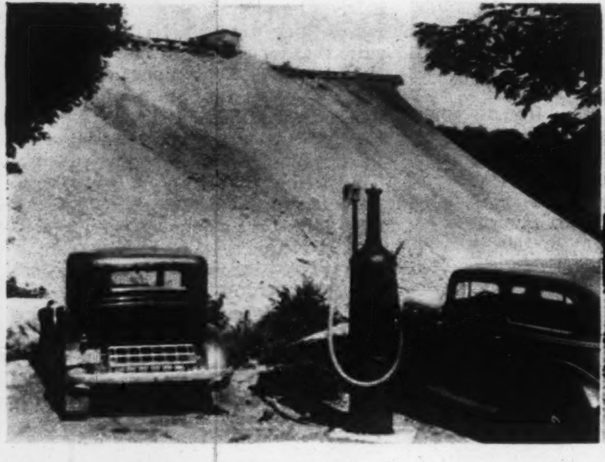


Fig. 6—Rock from tunnel after preliminary crushing and stockpiling by system of belt conveyors for plant producing coarse aggregate and sand.

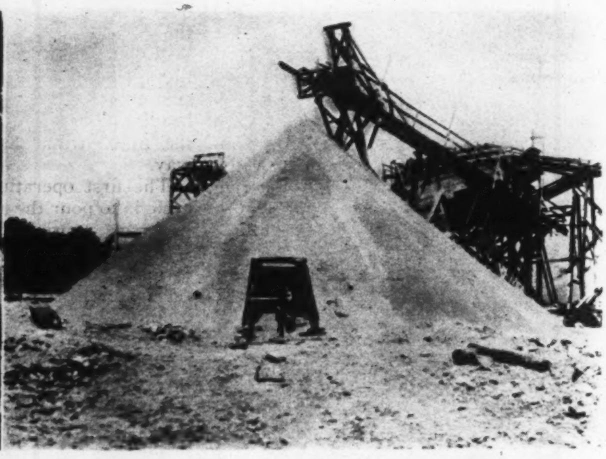


Fig. 7—Stockpile of large aggregate from crushing and screening plant, showing belt-conveyor tunnel for charging the concrete mixer bins.

require timbering. In other places where the rock is not structurally weak, but is of a formation that deteriorates rapidly upon exposure to air, a coating of Gunite is applied. A timbered section is shown by Fig. 1. Several timbering designs were suggested by the engineers, and the contractor was allowed to choose any one of them. The contractor developed a design of his own, which met with the approval of the engineers and which comprised wall posts 10x10 in. set on 4-ft. centers, the two lines of posts being 14 ft. 4 in. apart; on top of the posts at the springing line there was an 8x10-in. wall plate, and resting on the wall plate five-segment arches of 6x8-in. timber, the two lower segments being 3 ft. 5 in. long and the three crown sections 5 ft. 5 in. long, placed skin tight. Packing above the arch was stone only, no timber packing being allowed. No packing or lagging whatsoever was used on the sides. The timber was cut to exact shape and length outside of the shaft in a carpenter shop, which to some extent accounts for the cleanliness of the tunnel. There is no waste timber lying around, as is usual in most tunneling operations.

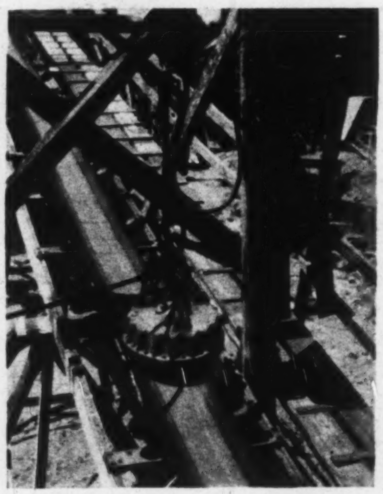
Muck disposal

A single-track railway, with a passing track at intervals, handled all excavated rock from headings to shafts. Small dump-cars in five-car trains were hauled by storage-battery locomotives. As a means of saving time, a battery-charging station was installed at the foot of each shaft and provided with spare batteries and with hoists for shifting batteries to and from the locomotives. Except for a major repair, no locomotive ever had to be taken to the surface. So also the muck cars were not hoisted but were dumped at the shafts into hoist skips. An air-hoist cable dumped one car at a time, one carload making a skipload. This hoist was handy in removing large stones lodged in the cars or in the skip-loading chutes.

The shafts were divided into two hoistways, one for the two alternating hoist skips and one for handling materials and equipment into and out of the tunnel. To prevent accident from objects which might fall, the entire shaft bottom at top of tunnel level, except the skipway, was closed by a steel trap-door. The skips hold 60 cu.ft. One was lowered as the other was hoisted; the hoists were electrically operated heavy-duty mine hoists. As a loading skip reached the top of the headframe, it dumped automatically into a hopper, which fed a primary crusher that made the first reduction of the rock to aggregate for concrete. Other shaft-head plant besides the hoists was a compressor plant, ventilating fans, drill sharpeners and furnaces, and a small repair shop.

From the primary crusher the muck was carried by a short belt-conveyor to the main belt-conveyor distribution system.

Fig. 8—Magnet hung over belt conveyor removes tramp iron from aggregate crushed from tunnel muck on final section of Quabbin tunnel aqueduct.



This main system consisted of an inclined trestle carrying a 24-in. belt. From the end of this trestle the stone was dumped into the pile. As the pile grew, the belt was extended in 50-ft. lengths on top of the muck pile (Fig. 6), creating a long and high stockpile. Only muck suitable for concrete aggregate was so distributed. Whenever unsuitable rock was encountered, it was dumped into the hopper as before but was bypassed around the crusher into a pile outside the crusher house. From this pile the rejected muck was removed by a slackline cableway.

Concrete production

For the lining operations now in progress a slackline cableway hauls the muck from the storage pile to the first crusher in the aggregate preparation system. From this crusher the muck travels up a long belt-conveyor, over which hangs a magnet (Fig. 8) to pick up all the tramp iron bound to get in the muck. From this conveyor the muck travels through screening and washing apparatus and is further crushed to provide the necessary fine aggregate. A little natural sand is added to the mix to overcome a deficiency in fines and to improve workability.

After the aggregate is properly screened and washed it is piled by belt-conveyor over a trap tunnel (Fig. 7), which in turn carries another belt-conveyor. As the aggregates are needed they are trapped into the trap tunnel and carried to the top of the mixing plant. Bulk cement is used exclusively, being hauled from a railroad siding, where it is received in container units, to the mixing plant in special covered trucks. The bulk cement is dumped from the trucks into a hopper at the bottom of the mixing plant and is transferred to the top of the plant by a system of screw and bucket conveyors. Each mixing plant contains one set of weighing and batching apparatus serving two 1-yd. electrically driven mixers. The mixers discharge directly into a common hopper, which, in turn, leads to an 8-in. pipe running down the shaft. At the bottom of the shaft where the concrete lands is a series of railroad rails set on end, with a hopper set off to one side into which the concrete flows after its fall is broken by the rails. From the hopper the concrete is gated into special concrete cars. These concrete cars are ingenious devices, being side-dump bodies built on the old muck-car trucks but with roller-bearing wheels added. The car bodies and dumping arangements were designed on the job.

Lining operations

The lining was placed first in the arch then in the sidewalls, and last in the invert, using the train of forms, tracks and concrete shooting plant shown by Fig. 9.

The form sections, both side wall and arch, are 125 ft. long. As the concrete trains approach the forms from the shaft end of the heading, the cars (four-car trains of 2-cu.yd. cars) are disconnected from the electric locomotive and are pulled up a Y-ramp by a cable operated by an electric hoist placed at the far end of the ramp, or at the beginning of the arch form section. The ramp is level for the 125 ft. along the side-wall forms; it carries two tracks, each close to the side wall. The side-wall forms carry a continuous apron extending out over the edge of the ramp floor, and the concrete is directed into the side-wall forms by dumping the cars onto the aprons. The cars can dump on one side only. Two trains are used in each heading, one train dumping one way, the other train dumping the opposite way.

The first operation in the concreting cycle is to pour the arch. Then the side-walls are poured, the arch forms being set with and adjacent to the side-wall forms. The ½-yd. air gun and air-receiver tank are set on the under side of the ramp, in the center, between the two tracks. When pouring the arch, the trains are reversed in the order sent up the ramp so that all cars dump toward the center instead of the outside. The hopper leading to the gun holds the load of one car.

Cars for the arch concrete are pulled up the ramp by cable. After a train is dumped, the locomotive runs up the ramp and hooks onto the empties. A snatch block at the top of the ramp incline allows for reversing the direction of cable pull in case the cars need to be moved without the locomotive.

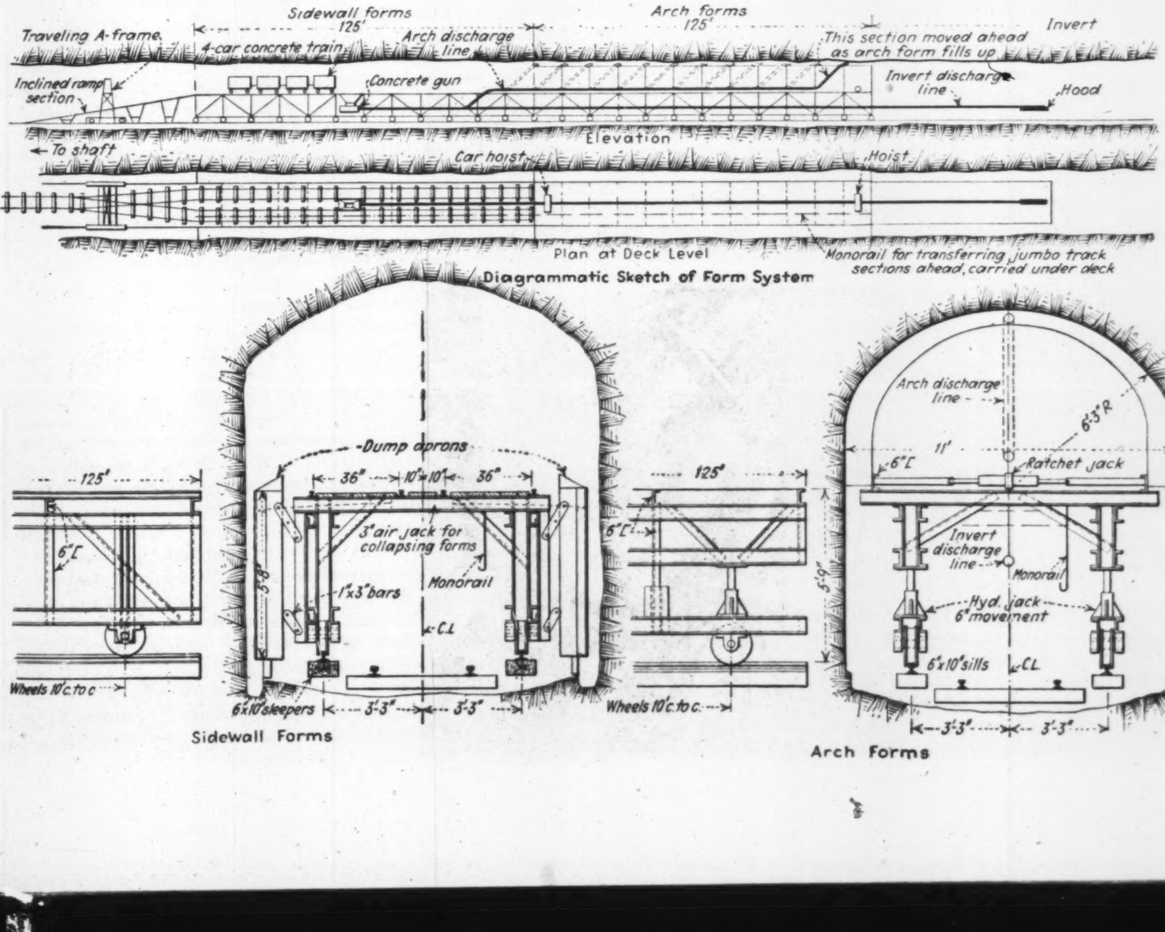
The arch forms, side-wall forms and both the horizontal and inclined sections of the ramp operate as a single unit on wide-gage tracks, the rails resting on longitudinal 6x10-in. sleepers cut to rail lengths to form track units. A monorail hangs from the under side of the form decks, and the heavy rail sleepers are moved from the back end of the arch forms to the front end of the ramp over this monorail. The inclined section of the ramp can be raised by a traveling A-frame when the whole unit is moved.

The arch forms are collapsible, as are the side-wall forms. The vertical motion or setting of the arch forms is accomplished with sets of hydraulic jacks placed under each rib of the form. The transverse motion of the side wall forms is controlled by air cylinders. The air and hydraulic jacking arrangements take the place of the usual hand-operated screw jacks.

The piping arrangement for the blowing of the arch concrete is unusual. Instead of having the pipe extend up over the front end of the form, between the top side of the arch form segment and the rock, the pipe is placed along the deck of the form in 10-ft. sections. A reverse-bend pipe leads from the gun to the deck or ramp level. The 10-ft. horizontal sections extend back into the arch form along the deck. At the start of a pour the back-crown section (next to the last section) is open. Through this opening leads another reverse-bend section of pipe, connected to the far end of the horizontal discharge line. As the back end of the form fills up, the crown plates are put in place, and the piping is moved ahead one length, discarding a 10-ft. length of the horizontal line. This process is repeated the full length of the form.

Concrete for the invert sections, always kept behind the arch sections, is discharged from the gun into a per-

Fig. 9—Operating diagram and form details of train of equipment for lining final section of Quabbn tunnel aqueduct.


Sidewall forms
125'
Arch forms
125'
Invert
Traveling A-frame
4-car concrete train
Arch discharge line
This section moved ahead as arch form fills up
Inclined ramp section
Concrete gun
Invert discharge line
Hood
Elevation
To shaft
Car hoist
Hoist
Plan at Deck Level
Monorail for transferring jumbo track sections ahead, carried under deck
Diagrammatic Sketch of Form System
125'
6"[
Wheels 10'c.to c
Dump aprons
36"
10"
10"
36"
3" air jack for collapsing forms
5'-8"
1"x3" bars
Monorail
CL
6"x10" sleepers
3'-3"
3'-3"
Sidewall Forms
125'
6"[
Wheels 10'c.to c.
5'-9"
Arch discharge line
6'-3" R
11'
6"[
Ratchet jack
Invert discharge line
Monorail
Hyd. jack 6" movement
6"x10" sills
CL
3'-3"
3'-3"
Arch Forms

manent horizontal line carried on the under side of the ramp and arch-form deck. This line is extended to the far end of the invert section. The discharge end of this line carries a split pipe hood, open at the bottom side, ending in a sloped baffle plate. As a section of invert is completed, the discharge line is removed 10 ft. at a time and the hood moved back correspondingly. The hood spreads the concrete a considerable distance on each side of the line, but much of the invert concrete has to be shoveled into final position.

The concrete forms and system are designed to pour 125 ft. each of side wall, arch and invert of each set-up. The sections of the arch form are collapsible by sections, so any multiple of 10-ft. length of form can be used. All concreting is done on the day shift, and all form-moving and setting at night.

There is a telephone connection between the forms, the bottom of the shaft, where cars are loaded, and the mixing plant. Also there is a colored-light signal system between the bottom of the shaft and the mixing plant to permit the man at the shaft bottom to call for concrete only as he needs it and can get it into the cars. There is little chance of concrete piling up in the pipe shaft, which would be disastrous.

General services

General tunneling services comprise ventilation, safety methods and machine-shop operations. The ventilation system for each shaft consists of a suction fan at the top of the shaft, which draws foul air out of both headings. The ventilation pipe is 12-in. spiral steel pipe and 12-in. wood-stave pipe. This wood pipe is in excellent condition despite its long use on the previous tunnel section, and is very easily handled. The staves are wrapped with a bituminous compound and are also given a wire wrapping. Wood-pipe joints consist simply of a wooden sleeve into which the taper ends of the pipe are driven. The pipe is capable of withstanding heavy shocks due to blasting.

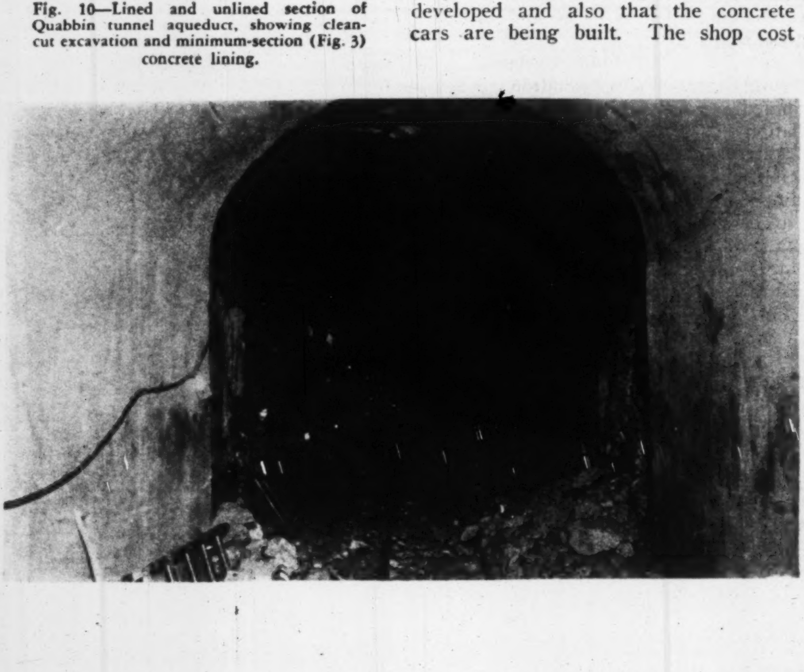


Fig. 10—Lined and unlined section of Quabbin tunnel aqueduct, showing clean-cut excavation and minimum-section (Fig. 3) concrete lining.

This contractor made safety work part of the job, not just an incident of the operations. In the first place, every man who goes underground, whether he is worker, foreman, superintendent or visitor, must wear a "hard-boiled" hat. These hats have saved more than one life and many a headache. Men are equipped with high-topped rubber boots, charged to them so that they will take care of them. The iron trap-door over the bottom of the shaft has been mentioned. Separate signals are used in hoisting to indicate whether it is merely a load of muck or whether men are riding the skips. All of the foremen and superintendents are regularly drilled on safety work. They, in turn, pass the instructions on to the men. The spirit of the safety work is remarkable. Regular safety dinners are a feature of the job, at which everyone takes part, including the workmen. To date there has not been a fatal accident on this entire 10-mile tunnel, a remarkable record when it is considered that practically all of the excavation work is now finished. All men are given a physical examination before starting to work and at regular intervals. A full-time safety engineer is employed by the contractor.

The machine shop, mentioned previously and located at the town of Gilbertville, where the contractor has his headquarters, is exceptional. It is completely equipped with all kinds of lathes, welding apparatus, power drills and punches, power saws and even a hydraulic press, which more than one manufacturing company in the neighborhood has used when its own shop could not handle a press job. The numerous trucks on the job are kept up in fine shape at this shop. It was at this shop that the mucking machine was developed and also that the concrete cars are being built. The shop cost many thousands of dollars to equip, but the contractor states that he has been paid many times over for its installation. Instead of the usual hodge-podge equipment and supplies, everything around the shop, including tools and equipment, is in its place. Many of the old pumps taken over from the previous contractor were rebuilt in this shop, some being changed from air to electric drive.

Personnel

The tunnel is being built for the Metropolitan District Water Supply Commission of Boston. Frank E. Winsor is chief engineer; Richard R. Bradbury is division engineer in charge of the tunnel; and Fred W. Gow and A. V. O'Malley are resident engineers. Charles T. Main, J. Waldo Smith and X. H. Goodnough are consulting engineers for the commission. The contractor is Wenzel & Henoch Co., of Milwaukee, Wis., with Otto P. Seefeld, vice-president in direct charge. Walter F. Hoeneke, now at San Jacinto, was general superintendent in charge until March 1, 1933, when he was succeeded by James Horan. Clarence W. Woodside is superintendent in charge of shafts Nos. 11 and 12; Walter Baer is superintendent in charge of shaft No. 10, and Thos. Gustafson is superintendent of shaft 9. Walter Hart is job engineer for the contractor.

Groundwater Resources of Northeastern Pennsylvania

For several years the United States Geological Survey and the Pennsylvania Topographic and Geologic Survey have been engaged in making a systematic study of the groundwater resources of the state of Pennsylvania. In connection with this general program, a detailed report has been prepared by S. W. Lohman on the groundwater resources of the northeastern part of the state, including Carbon, Columbia, Lackawanna, Luzerne, Monroe, Montour, Northumberland, Pike, Schuylkill, Susquehanna, Wayne, and Wyoming Counties and the northern part of Dauphin and Lebanon Counties.

In preparing this report all existing geologic information was utilized, and a large amount of hydrologic information was obtained in regard to more than 1,100 wells. Chemical analyses were made of 106 samples of water collected from wells and springs. Manuscript copies of the report are on file and may be consulted in the offices of the Pennsylvania Topographic and Geologic Survey at Harrisburg and of the United States Geological Survey at Washington. Inquiries concerning the occurrence and quality of the groundwater in this area may be addressed to either of these organizations.

Ammonia-Chlorine Treatment Yields Nitrites in Effluent

Soil bacteria in filter convert ammonia to nitrite, which presents large chlorine demand and interferes with the orthotolodine test for residual chlorine

By Roberts Hulbert
Senior Chemist, Department of Water Supply, Detroit, Mich.

PRESENCE of nitrites in the effluent of a rapid sand filter, brought about by the action of nitrifying bacteria in the filter bed, whose growth is encouraged by the ammonia used in conjunction with the chlorination process, has been found to be very pronounced at the Water Works filter plant at Detroit, Mich. Presenting a high chlorine demand, the nitrites cause a wastage of post chlorine, the chlorine being used up in oxidizing the nitrites to nitrates. In addition, the orthotolodine test for residual chlorine is likely to give misleading results as the nitrites also yield a yellow color. Waste of post-chlorine can be avoided in large measure by using sufficient ammonia in the pre-chlorination process to allow free ammonia to pass through the filters to combine with the post-chlorine to form chloramine. A 10-min. contact period for the orthotolodine test, with the sample stored meanwhile in a dark cabinet, has been found to give the true residual chlorine, as the nitrite color is slow to develop and depends to some extent upon the photo-chemical effect of sunlight.

Among hundreds of other uses, ammonia is now extensively employed, by trusting chemists, in the science of water purification to combine and fix chlorine as a chloramine. Used in this way, it is intended to prevent subsequent odorous combination of the gas with the soluble organic impurities of surface water The obvious fact that its use must certainly encourage the growth of nitrifying soil bacteria in the basins and filters of rapid sand plants seems to have been quite overlooked. Ammonia constitutes the particular and favorite source of growth energy food for these organisms, whose undoubted ability to oxidize its nitrogen is flaunted by the artistic nitrogen-cycle diagrams porrayed in every bacteriology and sanitary engineering text.

Proof of the biological origin of nitrate plant food in fertile soil came in 1877, to end one of the numerous and bitter controversies between the chemists and biologists of Pasteur's time. In that year Schloesing and Muntz quite definitely settled this particular argument with a very simple, yet altogether classic, experiment. They demonstrated that dilute solutions of ammonia were changed into nitrites and nitrates by slow passage through a glass tube filled with a long column of soil. After sterilizing the same soil sample with heat, or by means of treatment with a chemical germicide, the ammonia passed through unchanged. The struggle to isolate and grow the organism responsible for this oxidation process continued until 1890, when Winogradsky accomplished the feat by using a very simple sort of inorganic nitrogen salt solution, containing as an active ingredient sulphate of ammonia. Organisms capable of the primary transformation, that of ammonia to nitrite, he named *Nitrosomonas* and *Nitrosococcus.*

Now, obviously enough, multitudes of these nitrifying bacteria must be washed out of arable soils by drainage water in summer, to find their way thence to comfortable lodging in the basin sludge and sand beds of our filter plants, surprised, perhaps, to find in waiting their accustomed and favorite food in abundance. Aqua, anhydrous or sulphate of ammonia—often the chemist has a decided preference, but these bacteria seem not to have. Presently, whether the filter operator knows it or not, nitrites begin to appear in his hot-weather filter effluent, there to persist throughout the summer.

What portent has this formation of nitrite in filters? In his extensive 1931 research report on phenols and taste control, Braidech reported the presence of nitrite in tap water at Cleveland, as an outgrowth of ammoniation. He attributed its formation to the chlorine oxidation of ammonia in the presence of catalytic iron pipe. Other than to mention its interference with the orthotolidine residual chlorine test and offering a corrective for this, he seemed to attach no particular significance to this finding, thus failing to impress the casual and forgetful reader with this incident.

Observations at Detroit

Three years ago the feeding of sulphate of ammonia with alum, after prechlorination, was begun at Detroit. Each summer since then the demand for post-chlorine on the part of the filtered effluent has been unusually heavy compared to other seasons of the year. Strangely enough, until now this was not connected in the minds of those responsible for plant operation with the ammonia process. Not only this high demand for chlorine, but two other things—one an inconsistency and the other an absurdity in the orthotolidine residual tests—pointed to something amiss. Not content to call the high chlorine demand a seasonal phenomenon any longer, attributable possibly to high water temperature, it was determined to investigate in earnest, and if possible find out its real cause.

At the Water Works Park plant at Detroit the facts were briefly these: In the fall, winter and spring seasons a 0.24-p.p.m. (2.0 lb. per m.g.) post-chlorine dosage ordinarily suffices to yield a residual of 0.10 to 0.15 p.p.m.; at maximum water temperatures this summer, however, 0.30 p.p.m. dosage gave an average residual of only 0.04 p.p.m. according to readings made at night, and 0.11 p.p.m. during the daylight hours. The inconsistency between night and day readings continued with complete regularity. As it turned out later the night readings were true chlorine residuals, the daylight readings combined nitrite and chlorine color. Coincidently the filter effluent samples persisted in showing more intense ortho-color development than did the water applied to the filters, which was an absurdity because normally the chlorine content of the applied water is considerably diminished by passage through the filters. This likewise was found to be due to nitrite interference. Again, the unsually high summer season demand for chlorine on the part of the filtered water was eventually traced to the chlorine requirement of nitrite oxidation, which is surprisingly high, as will be pointed out later.

The consistent day and night variations in tap-water chlorine residuals suggested the effect of light on the ortho-chlorine-color development in the Nessler tubes. By testing filter effluent water containing nitrite, for color development both by exposure to daylight and in a dark cabinet, it was discovered that by daylight the ortho-yellow grew more and more intense up to a 30-min. contact period, while the dark sample developed no yellow color at all. Accordingly, for a time all readings on the filtered and tap samples were made after a 30-min. exposure under a mercury vapor lamp, both day and night. However, this technique likewise proved bad, since it merely served to develop fully all the nitrite-ortho-color, abetted by the long 30-min. reaction time specified in the new "Standard Methods." Furthermore, adoption of uniform light conditions when making the test did not correct the absurdity of higher residuals for filtered than for applied water, which seemed then to be strongly suggestive of the presence in one water of some interfering substance absent from the other.

Nitrites found in effluent

A search was then begun for some such unrecognized interfering substance. First hydrogen sulphide was sought for, then ferrous iron, manganese and nitrite. The search ended with nitrite. The filtered effluent gave a surprisingly strong positive test for nitrite nitrogen, a concentration of some 0.05 p.p.m.; the raw water contained, none, the applied water 0.005 p.p.m., and the tap water 0.02 p.p.m. Here, then, was the cause of many perplexing difficulties: a readily oxidizable substance in the filtered water which could consume post-chlorine, and at the same time one that interfered with the chlorine test by giving a false but identical color reaction. Nearly 0.30 p.p.m. of chlorine had been consumed by oxidizing nitrite to nitrate without, however, quite completing the job, since some unoxidized nitrite remained in the tap water and had been mistaken for residual chlorine. Luckily here the pre-chlorine had done its work before the addition of ammonia, otherwise a serious failure of the sterilization process would quite surely have resulted.

Conditions at other plants

What was the status of affairs at other plants using ammonia? Were they experiencing the same condition of nitrite formation, were they aware of the fact, and if so how were they avoiding trouble? Visits to four plants using ammonia in the vicinity of Detroit showed the same filtered-water-nitrite picture as at Water Works Park. Operators at these four plants carried no reagents in their laboratory for making tests for nitrite, much less were they aware of its presence. What then was the status of their tap-water chlorine residuals? These were checked by the old reliable starch-iodide test, and ample chlorine was found to be present along with the nitrites. Here was another poser: how could chlorine and nitrite be present in the same water? The answer is that they cannot; but chloramine and nitrite are not incompatible, they may exist together. Detroit's filter effluent contained no free ammonia to combine with the post-chlorine to form a chloramine, which would not have been consumed by the nitrite present. As at Detroit, two of these four neighboring plants using the standard 30-min. contact period were reading false high orthotolidine residuals—that is, they were reading not only chloramine color but nitrite color in addition; the other two still clung to the old 10-min., reaction time, which gives practically the true chloramine or chlorine reading.

Preventing nitrite interference

Now the question arises as to how the added nitrite color intensity may be prevented from interfering with the chlorine reading. Oxidation with hydrogen peroxide is recommended, but trials with this and other strong chemical oxidizing agents at Detroit have not proved dependable on chloramine solutions and were entirely unusable for free chlorine assay. The observed tendency for the nitrite color to develop slowly and only under the photochemical effect of strong light appears to offer a safer way to differentiate it from chlorine or chloramine color. When nitrite is known to be present, the Nessler tube should be placed in a dark cabinet, orthotolidine added, and after 10 min. the reading made in the light quickly avoiding unnecessary exposure. This technique appears to give the true chlorine color, which has been found to develop fully in the dark in 10 min. The nitrite-ortho-color requires strong light and 20 to 30 min. to develop.

This procedure, which is now used successfully in Detroit, is quite contrary to that recommended in the 1933 edition of "Standard Methods," which says: "In the case of waters . . . which have been treated with ammonia or ammonia compounds . . . the color development is retarded, and the sample should be allowed to stand for at least 30 min. after the orthotolidine is added and the reading is made." At Detroit this standard technique only served to develop the slow-forming yellow color of the nitrite-ortho reaction. Free chlorine ortho-yellow will fade out very markedly when exposed to daylight for 30 min. With but traces of chloramine present, the 30-min. daylight readings on the tap water were simply those of color formed by nitrite, and nothing else. They were, of course, being recorded in error as residual chlorine.

Nitrite oxidation wastes chlorine

The ammonia sulphate feed at Water Works Park has been discontinued twice this summer for periods of ten days or more to observe the effects on nitrite formation and residual chlorine readings. On both occasions the content of nitrite nitrogen in the filter effluent decreased in two days from an average of 0.05 to 0.005 p.p.m., whereas on July 15, with nitrite present, a post-chlorine dose of 0.30 p.p.m. yielded a tap residual of only 0.05 p.p.m.; and on July 31, with only a trace of nitrite present, a 0.12-p.p.m. chlorine dose gave a tap residual of 0.10 p.p.m. The indication here is that twelve times as much chlorine was used up when nitrite was present as when it was absent, and that about 0.23 p.p.m. of free chlorine was consumed by 0.04 p.p.m. of nitrite. This is a ratio of chlorine to nitrite nitrogen of about 6 to 1. According to the oxidation equation, the theoretical equivalent of 1 part of nitrite nitrogen is 5 parts of chlorine. Carefully controlled laboratory tests *in vitro* indicate that as much as 7 parts of chlorine to 1 part of nitrite may be required for complete oxidation of the latter.

It should again be emphasized that a true chloramine is quite compatible with nitrite. This was demonstrated in the laboratory to our complete satisfaction. It is a fact which points the way to avoidance of any considerable post-chlorine waste in reaction with filtered-water nitrite. The ammonia feed must be high enough to permit sufficient free ammonia to pass the filters to fix all the post-chlorine subsequently added as chloramine. To accomplish this at Detroit, the ratio of ammonia to pre-chlorine must be about 1 NH_3 to 2 Cl_2; on the basis of ammonia to total chlorine, this ratio is approximately 1 to 3. A good way to determine whether free chlorine is being wasted on nitrite oxidation or not is to compare the content of the latter in the filtered water just before with that soon after the addition of post-chlorine. If nitrite is less after than before, chlorine is oxidizing it, and thereby being wasted in an amount equal to about seven times the nitrite reduction.

Classic experiment repeated

Repetition of Schloesing and Muntz's glass-tube experiment, replacing their soil with sand from a filter bed, showed nitrite positive before sterilization and negative afterward. The top 6-in. sand layer was observed to be much more active in nitrification than deeper layers. Samples of sedimentation-basing sludge all gave strong positive nitrite reactions, although the basin effluent itself contains only a bare trace of it. Apparently in the sand beds conditions are most favorable for the biological process of oxidation

Attempts at cultivation of nitrifying bacteria from the filter sand have not been very successful, in so far as obtaining a plentiful growth of the organism itself is concerned, although the liquid culture media give a strong nitrite test after a few days' incubation, and scattering cells may be observed under the microscope.

The optimum-growth temperature range of both nitrous and nitric bacteria is given as between 25 and 30 deg. C. (77 to 86 deg. F.). On this basis it may be assumed that nitrite formation takes place only during the summer season when water temperatures are highest. This corresponds to observations at Detroit, where post-chlorine demand curve has been shown to follow the curve of rising water temperature quite closely, and perplexing difficulties with residual chlorine tests have been manifest only in summer. Nitrite formation in filter beds is perhaps another argument in favor of clean sand, although to prevent such formation, the sand in this case would have to be more than visibly clean. It would have to be bacteriologically sterile.

False Wheeler Filter Bottom Used in New Water Plant

At the Mahoning Valley filter plant a modified Wheeler filter bottom, used for the underdrain system, provides substantial economy and improves the hydraulic performance

By G. Gale Dixon
Consulting Engineer, Youngstown, Ohio

THE FOLLOWING ARTICLE is the second of a group describing the new Meander Creek water supply for the Mahoning Valley Sanitary District, which comprises the cities of Youngstown and Niles, Ohio. The first article appeared in the issue of March 30, 1933, p. 395. A third article describing the pumping facilities of the new water system will appear at an early date. —EDITOR.

THE FILTER PLANT of the new Meander Creek water-supply system for the Mahoning Valley Sanitary District is a structure entirely separate from the preliminary treatment works. Although much of the design of the filter plant itself does not differ greatly from common practice, in the filters themselves an adaptation of the Wheeler filter bottom is used, in this case termed a "false Wheeler filter bottom," for the underdrain system. This type of underdrain was developed about seventeen years ago, but it has not been widely used. In the Meander Creek plant its use has made possible appreciable economies in construction and in addition provides valuable hydraulic properties.

The filter plant comprises a structure housing ten rapid sand filters having a combined capacity of 40,000,000 gal. daily (40 m.g.d.) with clear-water wells beneath them, and the abutting administration building, which contains offices, laboratories, washwater pumps, storage tanks and chlorinating equipment.

The administration building is a three-story steel-framed brick structure with deep basement, 46 ft. by 87 ft. in external plan dimensions. The front entrance opens into a circular corridor with wrought-iron railing about a central circular depressed pump room containing the motor-driven washwater pumps. Immediately opposite the front entrance, curved stairways lead downward from both sides of the corridor to the entrance to the filter-operating gallery, which is 5 ft. below the ground-floor level.

Just to the right of the front door is an alcove off the circular corridor containing the filter operator's desk, an instrument board carrying the meters and controls of the washwater equipment and the various water-level gages and alarms. From this station the operator has a good view of the interior and of the approach to the building, of the various gages, and of the illuminated dials of the clock and the raw-water venturi meter, which are suspended from the ceiling in front of the doorway leading to the operating gallery.

The offices and chlorine room are on the ground floor. Axial stair halls extend from the circular corridor to both ends of the building, with stairways up to the laboratories, drafting and locker rooms on the second floor; from one end stairs go down to the pump-room floor and thence to the sub-basement and pipe gallery.

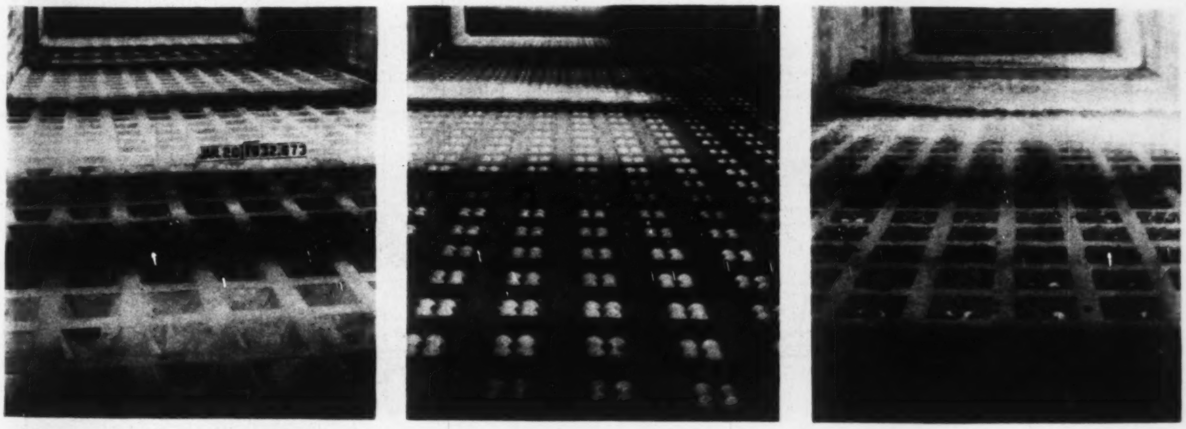


Fig. 1—The filter underdrain system comprises a Wheeler filter bottom built into a concrete slab, beneath which there is a 23-in.-deep pressure chamber. These three views show the Wheeler bottom in various stages of construction. Pyramid-shaped pockets are cast in the slab, each provided with a ¾-in. nozzle at the bottom, opening into the pressure chamber below. Porcelain spheres are placed in the pockets to distribute the rising wash water. The pockets are filled flush with the top of the slab with coarse gravel.

Filters

The filter house is about 147 by 142 ft. in outside dimensions, inclosing a double row of filters grouped about a central operating gallery 20 ft. wide. The operating gallery is railed, with gates giving access to concrete runways over the tops of the filters. The roof over the filters is supported by exposed steel trusses at a height of about 14 ft. above the floor level, while the clerestory over the operating gallery extends to about twice that height. The building is heated by two unit heaters located in the administration building, one blowing centrally across each row of filters; additional heat in the operating gallery is afforded by radiators located on the pipe gallery walls beneath railed openings in the floor.

There are ten filter units, each of 4-m.g.d. capacity when operating at the rate of 125 m.g.d. per acre. The two rows of five filters each on opposite sides of the pipe gallery are built on the roofs of clear-water wells of concrete groined-arch construction, with water depth of 9 ft. and combined content of 1 m.g. The two clear-water wells are connected by short, valved, 54-in. cast-iron pipes to a reinforced-concrete conduit that runs through the foundation of the administration building on the extended center line of the pipe gallery and conveys the filtered water to the suction well of the pumping station across the road. The pumps, conduit and clear-well connections are at such levels that all the storage in the clear-water wells is effective.

Each filter unit is 57 ft. long and 28 ft. 3 in. wide between walls, divided longitudinally into two halves by a central washwater gutter, each half having a net filtering area 57 ft. long and 12 ft. 3 in. wide. Each half filter has eight lateral washwater gutters, with the lip located 30 in. above the surface of the filter sand and with a clear space of 5 ft. 1½ in. between them. These lateral gutters discharge into the central gutter.

The plant is designed for washing

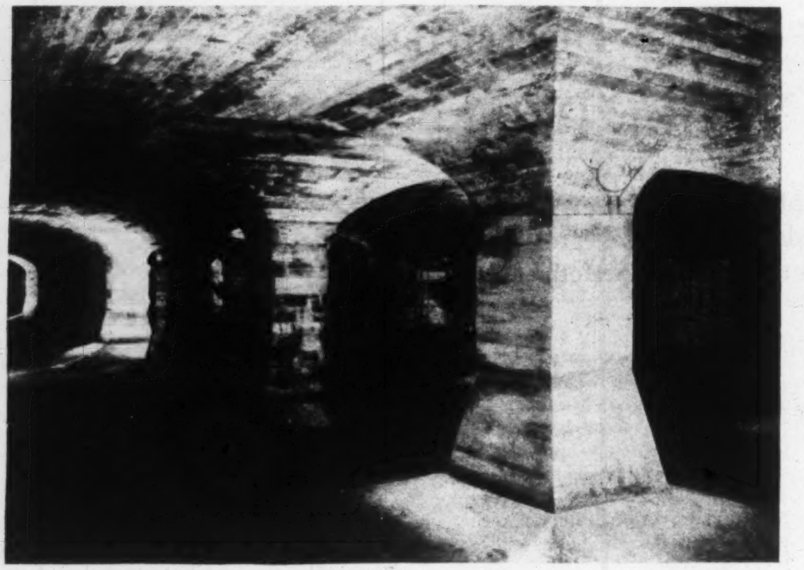


Fig. 2—Beneath the filters there is a 1-m.g. filtered-water reservoir, of concrete groined-arch construction.

filters at an ordinary maximum rate of 36 in. vertical rise per minute; the actual maximum capacity is slightly in excess of that rate.

The underdrainage or "strainer" system is of the type that may be designated as the "false Wheeler filter bottom," consisting of a "false bottom" with the "Wheeler bottom" incorporated in it. The false bottom is a reinforced-concrete slab 7 in. thick, with the pyramidal depressions of the Wheeler design cast in it in a uniform pattern on 12-in. centers; from the pit of each depression, a $\frac{3}{4}$-in. brass thimble extends through to the bottom of the slab, forming a short tube connection with a pressure chamber underneath. The slab is supported on small reinforced-concrete piers at a height of 24 in. above the structural floor of the filter, forming a chamber under the whole area of the filter through which a man can crawl for maintenance purposes. The false bottom is reinforced so as to withstand safely all pressures that may come upon it from either direction, and it is securely anchored to the walls of the filter and through the piers to the structural floor. Access to the pressure chamber from the pipe gallery is afforded by an 18 by 24-in. elliptical manhole on each side of each unit.

The filter influent is admitted to the central washwater gutter by a 30-in. pipe connection from a reinforced-concrete influent conduit supported on columns from the pipe gallery floor; a 30-in. branch from the same pipe carries waste water to the sewer during washing. The washwater main is 36 in. in diameter with two 20-in. connections to the pressure chamber of each filter unit, one centered on each half-filter. The filter effluent from the pressure chamber to the clear-water well passes through a separate 20-in. connection with a rate controller.

All filter valves are hydraulically controlled from the operating tables, except the 10-in. "rewash" or filtered waste valve, which is hand-operated. The two washwater valves of each unit respond together to a single control on the operating table.

The filtering medium is 21 in. of Ohio sand having a uniformity coefficient of 1.36, an effective size of 0.43 mm. and a 30 per cent size of 0.505 mm.

The filter sand is immediately underlain by a 6-in. layer of coarse silica sand or "torpedo gravel" having an effective size of 1.21 mm. and a uniformity coefficient of 1.28. Beneath this are four layers of graded gravel, totaling 12 in. in thickness, ranging in size from particles retained on a No. 12

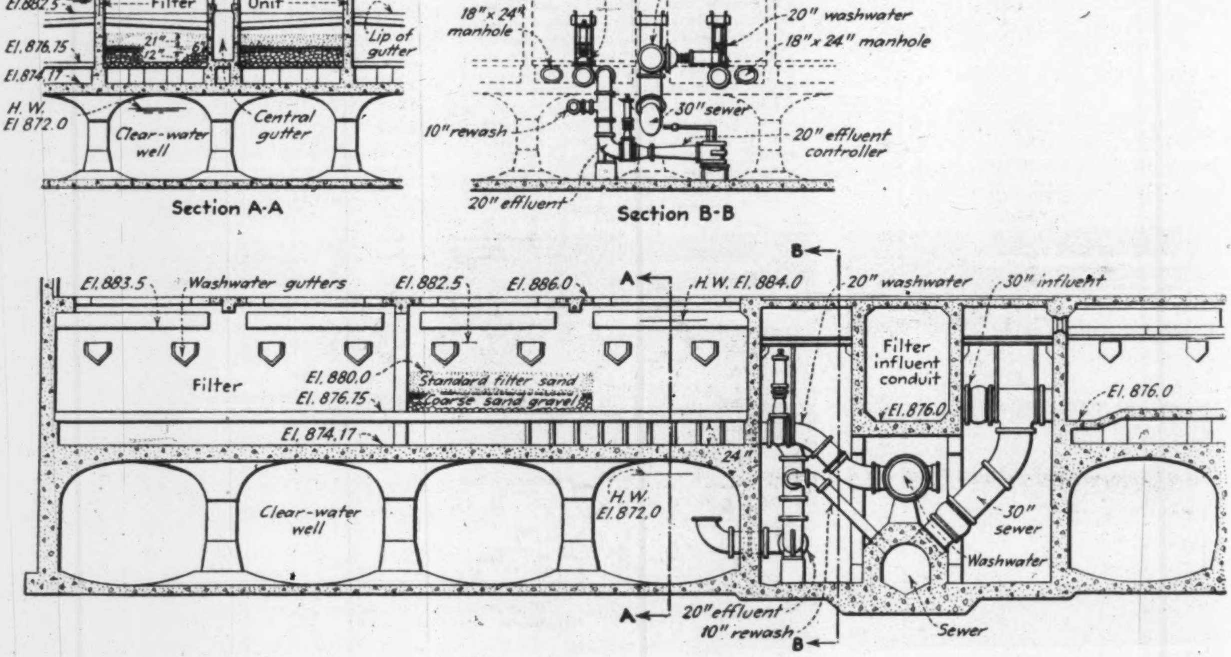

2'-7"
El. 886.0
12"
7"
7"
12"
12'-3"
12'-3"
El. 884.0
El. 882.5
Filter
Unit
Lip of gutter
El. 876.75
21"
12"
6"
El. 874.17
H. W. El 872.0
Clear-water well
Central gutter
Section A-A
20" washwater
30" influent
18" x 24" manhole
20" washwater
18" x 24" manhole
30" sewer
10" rewash
20" effluent controller
20" effluent
Section B-B
B
El. 883.5
Washwater gutters
El. 882.5
El. 886.0
A
H. W. El. 884.0
20" washwater
30" influent
Filter
El. 880.0
Standard filter sand
El. 876.75
Coarse sand gravel
Filter influent conduit
El. 876.0
El. 876.0
El. 874.17
24"
Clear-water well
H. W. El. 872.0
30" sewer
Washwater
A
20" effluent
10" rewash
B
Sewer

Fig. 3—Cross-section through the filter plant, showing the simplified piping arrangement made possible by the use of the false Wheeler filter bottom.

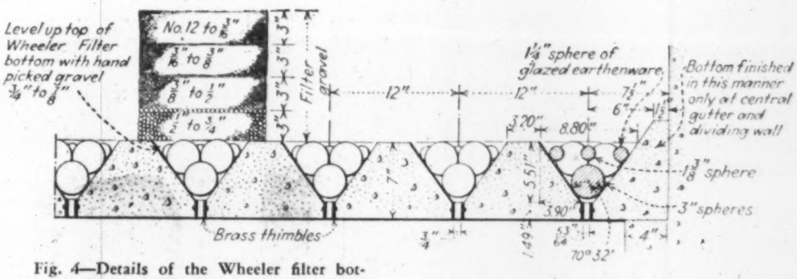

Level up top of Wheeler Filter bottom with hand picked gravel $\frac{3}{4}$" to $\frac{7}{8}$"
No. 12 to $\frac{3}{16}$"
$\frac{3}{16}$" to $\frac{3}{8}$"
$\frac{3}{8}$" to $\frac{1}{2}$"
$\frac{1}{2}$" to $\frac{3}{4}$"
3"
3"
3"
3"
Filter gravel
12"
12"
$7\frac{1}{2}$"
6"
$1\frac{1}{2}$"
$1\frac{1}{4}$" sphere of glazed earthenware
Bottom finished in this manner only at central gutter and dividing wall
3.20"
8.80"
7"
5.51"
$1\frac{3}{8}$" sphere
3" spheres
3.90"
Brass thimbles
$\frac{3}{4}$"
1.49"
$\frac{53}{64}$"
4"
70° 32'

Fig. 4—Details of the Wheeler filter bottom. Rising washwater is distributed by porcelain spheres fitting neatly in a pyramid-shaped pocket.

screen at the top to pieces passing a $\frac{3}{4}$-in. opening and retained on a $\frac{1}{2}$-in. opening at the bottom. The gravel is of silicious character, also produced in Ohio.

The Wheeler filter bottom

The Wheeler filter bottom was invented by the late William Wheeler, of Concord, Mass., and was patented by him in 1915. The first installation was made at Belfast, Me., by Robert Spurr Weston, following experimentation by him in 1913, which resulted in definitely establishing the details of design.

The first instance of its application in a plant of relatively large size was in the original plant at Akron, Ohio, by F. A. Barbour, following further experiments made in collaboration with him in 1914 by the late James E. Williamson, then chief engineer of the New York Continental Jewell Filtration Co., the contractors on that work.

Other examples of its use in relatively large works prior to the present instance include Chester, Pa., Charleston, S. C., Cambridge, Mass., and the enlargement of the plant at Little Falls, N. J. In addition, it has been used in perhaps a dozen smaller installations.

The unit of the Wheeler bottom is a 12-in. square of floor containing a depression in the form of a frustum of a pyramid 8.8 in. square at floor level and 1 in. square at the bottom depth of 5.51 in. The pit of the depression neatly accommodates the end of the $\frac{3}{4}$-in. brass tube that connects with the lateral underdrain or the pressure chamber beneath.

In the bottom of each depression, centered over the brass tube, a single 3-in. porcelain ball is placed, then four more in a single layer above the first; the spaces left between the four 3-in. balls and the sides of the depression are then filled by eight $1\frac{1}{4}$-in. clay marbles, with a ninth marble of $1\frac{3}{8}$-in. diameter in the center between the four balls, and the whole surface is then leveled off with hand-picked gravel between $\frac{3}{4}$ and $\frac{7}{8}$ in in size flush with the concrete rims of the depression. Above this level the several graded layers of gravel are placed. The pyramidal depressions are mathematically exact in dimension, so that the various balls fit into them with point contacts.

Among the merits of the Wheeler design are simplicity and ruggedness of parts and the freedom from corrosion or other depreciation of the materials used in its construction. It is a sort of conventionalized downward extension of graded gravel to the large size suitable for accommodating the relatively large and widely spaced orifices.

The fundamental principle underlying the special hydraulic merit of the Wheeler bottom is in the "ball nozzle effect" which results from the centering of the lower 3-in. ball directly in the path of the issuing jet of washwater. The experiments reported by Barbour (*Transactions*, Am.Soc.C.E., Vol. 80, p. 1411) demonstrated that the impinging jet produced a vacuum between the surface of the ball and the water enveloping it, and that the discharge of the tube under a given head was actually increased in the presence of one ball as compared to unobstructed discharge.

As the water continues upward within the expanding limits of the depression, it successively envelopes the four 3-in. balls and the layer of marbles, entering the bottom of the graded gravel with quite perfect uniformity of distribution.

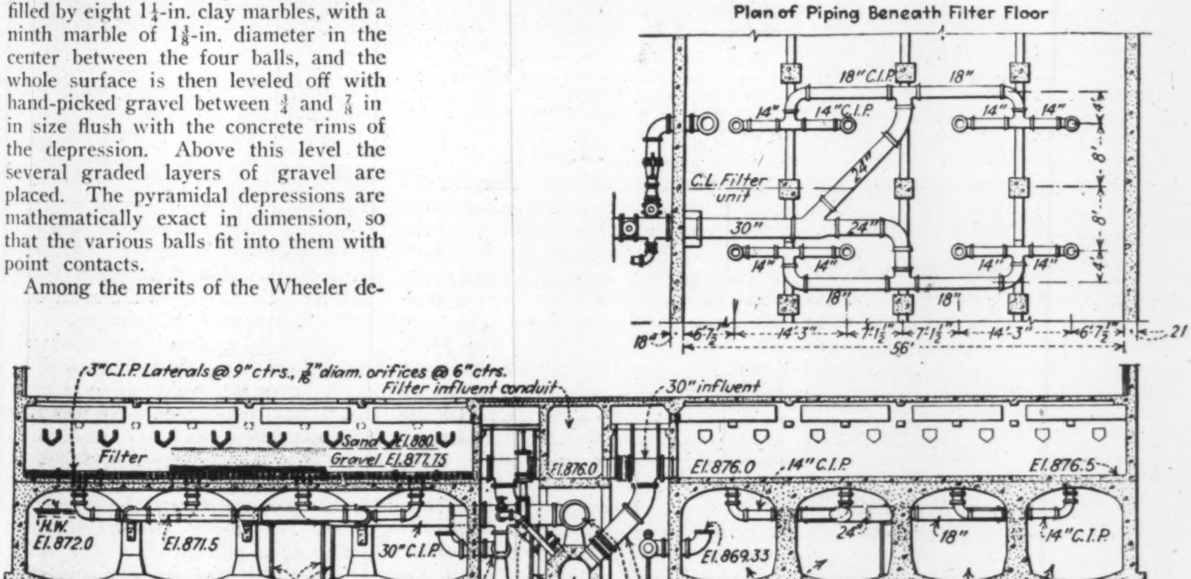
Weston reports (*Engineering News*, July 2, 1914, p. 22) experimenting with washwater rates as high as 60 in. per minute, and that with three layers of graded gravel totaling 6 in. in thickness "in no case was the gravel disturbed." Barbour states (ibid.) that in experiments with washing "at rates up to and exceeding 48 in. per minute, there is no perceptible movement of a 6-in. gravel layer."

Experience has indicated the wisdom of using gravel beds thicker than were employed in the experiments; this is doubtless due to the fact that on large areas it is practically impossible to secure uniform spreading of the very thin layers of graded gravel that are required in order to limit the total thickness of the bed to 6 in.

The false Wheeler filter bottom

By incorporation of the Wheeler design in a false bottom, the virtues inherent in the two types of construction are compounded. The following advantages are added to those already enumerated for the Wheeler bottom:

Fig. 5—Alternate design for a perforated-pipe underdrain system. A comparison of costs led to its rejection in favor of the false Wheeler filter bottom.


Plan of Piping Beneath Filter Floor
18" C.I.P.
18"
14"
14" C.I.P.
14"
14"
24"
C.L. Filter unit
30"
24"
14"
14"
14"
14"
18"
18"
4'
8'
8'
4'
18"
$6'7\frac{1}{2}$"
14'3"
$7'1\frac{1}{2}$"
$7'1\frac{1}{2}$"
14'3"
$6'7\frac{1}{2}$"
21
56'
3" C.I.P. Laterals @ 9" ctrs., $\frac{7}{16}$" diam. orifices @ 6" ctrs.
Filter influent conduit
30" influent
Sand El. 880
Filter
Gravel El. 877.75
El. 876.0
El. 876.0
14" C.I.P.
El. 876.5
H.W. El. 872.0
El. 871.5
30" C.I.P.
El. 869.33
24"
18"
14" C.I.P.
20" effluent
10" rewash
Sewer
30" sewer
Washwater
Clear-water well
$2\frac{1}{2}$" W.I. Pipe columns

There is substantially no loss of head in the pressure chamber, as compared to a considerable loss in design involving a grid of lateral pipes or channels and a system of collecting piping. It is estimated that a saving of about 12 ft. in required head was effected in the Mahoning Valley installation, as compared to the alternative design that was considered, for a wash rate of 36 in. per minute.

Uniformity of distribution of washwater over the whole area of the filter.

Accessibility for maintenance purposes.

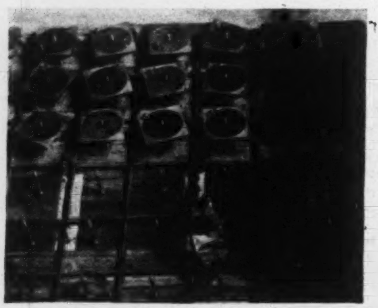


Fig. 6—Forms for filter bottom. In this view the under form for the false bottom is in place, with the tops of the concrete supporting piers showing through. Cast-iron forms for the pyramidal pockets are held in place by bolts passing through the brass thimbles. The upper layer of reinforcing steel, which in the picture is lying on the floor, is raised to its proper position after the pocket forms are lined up.

In past years the false-bottom design has been criticized on the ground that the relatively large space in the pressure chamber might encourage aftergrowths of bacteria. In the light of the experience of many years of operation of false-bottomed filters in several good-sized plants this point does not seem significant.

The false Wheeler filter bottom was installed by William Wheeler at Winchester, Ky., in 1917, and by the writer in the enlargements of the Akron, Ohio, plant put in service in 1919 and in 1922.

In the writer's experience this design has proved less expensive than either the plain false bottom or the perforated pipe underdrainage system with which it has been put in actual competition.

Comparison of costs

In contracts let for two successive enlargements of the Akron filter plant in 1917 and 1920, alternative bids were received upon plain false filter bottoms and upon other designs. In each instance the contract was let to the low bidder, who was low on the basis of all alternatives.

The Akron filter units are of 2-m.g.d. capacity each, designed for washing at the rate of 24 in. rise per minute. The plain-false-bottom design called for in the contract drawings consisted of a reinforced-concrete slab 7 in. thick supported on concrete posts over a pressure chamber 23 in. deep. Brass tubes and "strainers" of ⅜-in. diameter were spaced 6 in. apart in both directions, with 18 in. of graded gravel and 10 in. of coarse sand underlying a 20-in. bed of standard filter sand.

The following tabulation shows comparative costs on the basis of the two sets of alternative bids:

	Plain False Bottom	False Wheeler Bottom
Bids received Aug. 7, 1917 **5 units of 2 m.g.d. each**		
Underdrainage system	**$14,000**	**$12,270**
Additional filter gravel, 6-in. thickness	**770**	......
Total cost for 5 units	**$14,770**	**$12,270**
Cost per m.g.d. filter capacity	**$1,477**	**$1,227**
Bids received Sept. 17, 1920 **10 units of 2 m.g.d. each**		
Underdrainage system	**$31,000**	**$25,900**
Additional filter gravel, 6-in. thickness	**3,280**	......
Total cost for 10 units	**$34,280**	**$25,900**
Cost per m.g.d. filter capacity	**$1,714**	**$1,295**

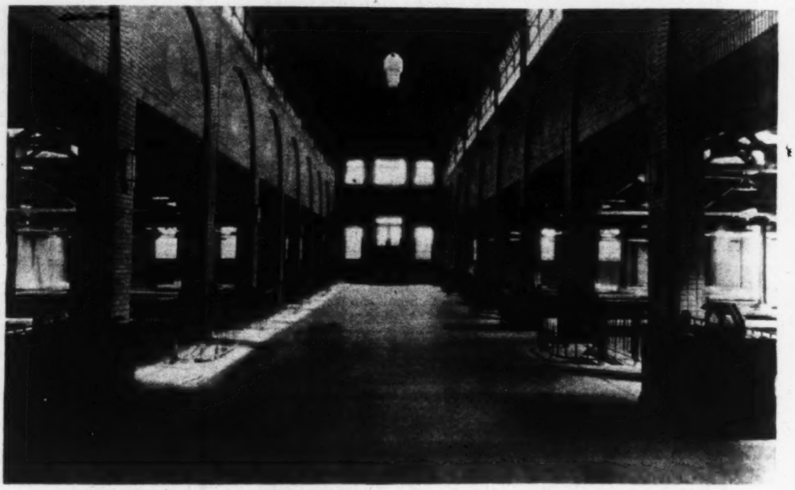


Fig. 7—View down the operating gallery of the filter plant. There are five filters on each side of the gallery, with a combined nominal capacity of 40 m.g.d.

The contract drawings for the Mahoning Valley plant detailed an underdrainage system of the perforated-pipe type, with collecting piping in the clear well beneath the filter, and alternative proposals were invited on other types of underdrainage systems.

The contract design (Fig. 5) involved a single 30-in. wash water connection to each unit, branching in the clear-water well to make four 14-in. pipe connections in each half-filter to a sectional cast-iron manifold lying on the center line of each half unit. The laterals were to be 3-in. cast-iron pipes spaced 9 in. apart, with $\frac{7}{16}$-in. brass bushings set in holes drilled in the bottoms of the laterals on 6-in. centers. Total thickness of graded gravel was to be 21 in.

The following tabulation shows the contract cost of the false Wheeler filter bottom as actually installed, in comparison with the contractor's bid on the perforated-pipe underdrainage system.

	Perforated-Pipe Under-Drainage System	False Wheeler Filter Bottom
Bids received Sept. 19, 1930 **10 units of 4 m.g.d. each.**		
Underdrainage system	**$31,000**	$45,000
Pipe connections	**14,733**	
Additional filter gravel, 9-in. thickness	**2,911**	
Total cost for 10 units	**$48,644**	$45,000
Cost per m.g.d. of filter capacity	**$1,216**	$1,125

Washwater equipment

Washwater is stored in two cylindrical steel tanks, 36 ft. in diameter and 14 ft. deep on the third floor of the administration building, which is of such size as just to give convenient passage space about them. At normal water depth of about 11.5 ft., the two tanks hold 165,000 gal., equivalent to a 36-in. wash of 5¼-min. duration. The bottoms of the tanks are 35 ft. above the lips of the gutters of the filters. Both tanks have overflows of liberal size, which discharge into the clear-water well through a 16-in. pipe.

The main washwater pipe is 36 in. in diameter, with a gated connection into the bottom of each tank. Either tank may thus be cut out of service for maintenance or repair, and operation may be continued with the other. An 8-in. blow-off connection from the bottom of each tank discharges to the main drain in the basement of the building.

The rate of application of washwater to the filters is regulated by a controller in the basement, which is so piped up that it may be bypassed when necessary. The controller consists of a butterfly valve located in the throat of a 36-in. by 24-in. venturi tube, driven through a balanced set of worm gears by a reversing motor. The rate is established by the setting of a pointer on a dial on the instrument board in the operator's room; the actual rate in washing is indicated and recorded at the instrument board and is also indicated on a large illuminated dial in the operating gallery. The design of the controller is such that it is in closed position at the start of a wash.

Two motor-driven centrifugal washwater pumps are located in the depressed pump room, occupying half of the available space. Each pump has a capacity of 2,000 gal. per minute against a total head of 60 ft., and is driven by a 40-hp. squirrel-cage motor controlled by float switch from the washwater tanks.

The pumps have indepenednt suctions with foot valves, each drawing from a separate suction well with gated connection to the filtered-water conduit in the foundation of the building. The pumps are set at such elevation that they can operate with the clear-water wells at low-water level. Each pump is equipped with a check valve of the automatic-cone-valve type, controlled by a solenoid. A 24x10-in. venturi tube in the common discharge pipe actuates indicating and recording devices on the instrument board in the operator's room.

Chlorination equipment

The chlorine room is 14x16 ft. located in the left-hand rear corner of the ground floor, with an outside door opening on a driveway for the delivery and removal of cylinders. It is entered from the corridor through double doors and an ante-chamber, in which is a work bench with sink and chlorinated-water sample tap for making hourly determinations of residual chlorine by the operator.

The partition between the chlorine room and the anteroom is made of plate-glass, and all doors have large glass panels.

The chlorine room is ventilated from the outside by adjustable louvres at floor level; a motor-driven exhaust fan, controlled by a switch in the antechamber, discharges through a duct leading up through the roof.

In the chlorine room are duplicate chlorinators of the vacuum type, fed from cylinders that stand on a flush platform scale equipped with a large indicating dial and with recording mechanism. Duplicate rubber hoses are provided for conveying the gas solution to a hard rubber and bronze grid in the filtered-water conduit in the foundation of the building. A small quantity of ammonia is applied to the filtered water a short distance above the chlorine grid.

Personnel of the Sanitary District

From its inception the Mahoning Valley Sanitary District has been managed by a board of directors consisting of Jacob D. Waddell, president, of Niles, and Fred A. LaBelle, secretary-treasurer, of Youngstown.

The engineering work was directed by William H. Dittoe, chief engineer, and the writer was deputy chief engineer. The architectural treatment of the several buildings is the work of Charles F. Owsley, architect, of Youngstown.

Storage Tank Operation To Aid Pressure Conditions

Elevated tanks in Milwaukee boost pressures during summer peak loads due to afternoon sprinkling, thereby saving installation of excessive pumping equipment

By E. F. Tanghe
Office Engineer, Department of Public Works, Milwaukee, Wis.

DUE PRIMARILY to the rapid growth in area of the city of Milwaukee, a small district on the south side of the city, about 12 miles from the nearest pumping station, formerly experienced poor water pressure during the sprinkling peak. On several occasions this district was without water for a period of two hours at a time. Studies to determine how best to relieve this situation resulted in the installation of elevated storage.

The addition of another pump at one of the existing pumping stations would not solve the problem because of the pressure loss in the distribution system during the peak consumption demand. Enlarging the feeder-main capacity to the poor-pressure area would have helped, but the cost of a long line of pipe parallel to the existing feeder main would have been considerable. A new major pumping station will be needed eventually, but it was with the idea of postponing this large expenditure for tunnels, mains and pumping station that elevated storage was considered.

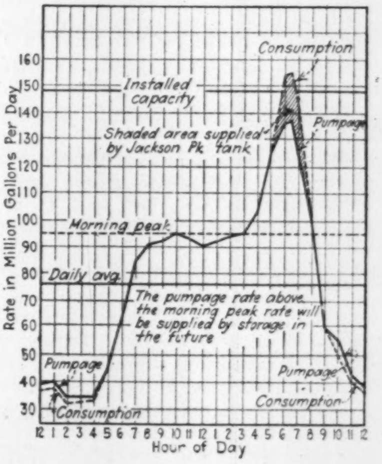
There is no elevation in or near the city suitable for a reservoir in the high-service district. This led to locating a site for an elevated tank near the existing feeder main. The tank was placed in a wooded park so that it would be partly hidden from view. The park is 2½ miles from the area experiencing poor pressure. The tank is fed directly by a 20-in. main and in a somewhat roundabout way by a 12-in. line.

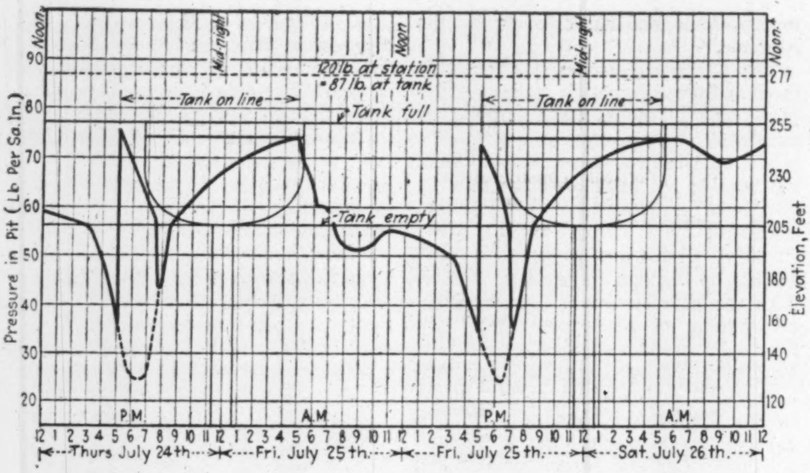
Recording pressure charts were obtained at the chosen site to help determine the height of tank to be built. A 1,500,000-gal. tank, 50 ft. in depth, with overflow at elevation 255 ft. above city datum, or 175 ft. above the ground, was chosen. The overflow was kept 22 ft. below the static pressure elevation so as to insure the tank's filling over night. An automatic altitude valve, hydraulically operated, prevents overflow by disconnecting the tank from the distribution system when the proper level of water in the tank is reached. This same valve, with the aid of a timing device, automatically places the tank on the line at 5 o'clock in the afternoon. By operating the tank in this manner its contents can be used when needed most—that is, during the sprinkling peak.

Recording pressure charts now taken at the tank site itself are changed daily to obtain a record of the effects of storage and also to make sure that the automatic devices are functioning properly at all times. On the peak consumption day the tank discharges water at a rate of 18 m.g.d., the equivalent of a fair-sized pump. The pressures in the distribution system are boosted varying amounts depending upon the distances from the tank and upon the rates of consumption for the entire city. The area which formerly was without pressure during the sprinkling peaks now has a minimum pressure of 20 lb. per sq.in. on the maximum pumping days.

The tank fills during the night, is automatically disconnected from the distribution system when full and remains off the line until about 5 p.m. of the next day. At this time the altitude valve opens and the water flows from the tank into the distribution system. The immediate rise in pressure at the tank site has been as much as 40 lb. per sq.in. on several occasions. This pressure rise represents the difference between the pressure in the mains and that represented by the elevation of the water in the elevated tank at the time the altitude valve opens. As the water level in the tank drops, the pressures in the surrounding area gradually decrease; but

Total high-pressure pumpage curve for 24 hours on a peak day which is typical of any hot day.





Pressure curves for four days at Jackson Park tank, showing the fluctuations with tank on and off line.

before they drop to the value they had had when the tank was cut in, the sprinkling peak has been passed, the pressures in the distribution system are increasing and the tank begins to fill.

The capacity of this tank is only 2 per cent of the high-service pumpage on a hot day. Studies have been made to determine the feasibility of increasing this ratio of storage to pumpage. The highest elevation in the city is 65 ft. below the static head pumped against in the high-service system. This means that natural reservoir sites are not available. However, another 1½-m.g. elevated storage tank is being built at the present time. In addition, booster pumps will pump the water from a ground storage tank into the distribution system during the sprinkling periods. No attempt will be made to use any of these tanks during the winter months.

Pumping curves in the high-service system on hot days are very much alike. From a low demand during the night there is a rapid increase between 5 and 7 a.m., culminating in a morning peak at 10 a.m. After a slight recession around noon there is another increase in demand, reaching a peak at 7 p.m. From this evening peak there is a decided and rapid falling off in the pumpage rate. To adjust the pumping to this very irregular consumption demand requires the throttling, speeding up, putting on and taking off of pumps, with a loss in efficiency due to this irregular operation of pumps. The demand for water during the sprinkling peak is at a rate double that for the pumpage (24 hours) of the maximum day of the year and is equal to four times the year's average daily pumpage. The evening peak demand is about 60 per cent higher than the morning peak on a very hot day. This additional 60 per cent pumping requirement is the load that it has been attempted to supply by means of storage tanks and booster pumps.

A few of the gains that it is hoped to make are as follows:

1. A more continuous operation of the large-capacity pumps.
2. A saving in interest and depreciation on the large investment that would be represented by a new major pumping station, mains and tunnels.
3. Reduction in the high velocities in the feeder mains during peak-consumption hours.
4. Delay in building a new intake by cutting down the peak pumping rate by about 33⅓ per cent.
5. Reduction of large fluctuations in pressure by reducing the large fluctuations in velocities.
6. Increase in the use factor of pumps in the two major stations.
7. Reduction in the required capacity of the proposed filtration plant, or of the storage required at the plant.
8. More flexible plant installations. Additions can be made in small units.
9. Increase in pressures in the outlying areas by placing the storage in those areas.
10. Smaller feeder main capacity required because the system would be fed from several points during peak demands.

The installation of storage facilities as well as the preliminary studies were carried out under the direction of J. P. Schwada, city engineer.

Willamette Valley Sanitary Program Outlined in Report

Sewage-disposal plans for important Oregon area containing 64 per cent of state population outlined by engineering board as first step in a coordinated public-works program

RECOMMENDATIONS for a comprehensive program of sewage-disposal projects for 65 communities in the Willamette River valley, which contains 64 per cent of the population of Oregon, are contained in the report of an engineering board that will form the basis for an extensive public-works development. The board, consisting of Ray E. Koon, chairman, John W. Cunningham and Robert G. Dieck, all consulting engineers of Portland, was appointed by Governor Meier following a conference of representatives from the cities on the river, which recognized the wide public demand for abatement of stream pollution and authorized the survey as the first step in instituting a properly balanced program of improvement. The report of the board was released for review by the interested communities on Sept. 3; the essential findings and recommendations contained in the board's report are abstracted in the following.

Time allowed for the preparation of the report did not permit extensive technical study of the problem, and the board's conclusions were based on: (1) visits by the board to each of the communities for first-hand information on the local problem; (2) meetings with industrial representatives on problems of industrial waste disposal; (3) existing documentary and engineering data; and (4) Oregon State College bulletin "A Sanitary Survey of the Willamette Valley," 1930.

The Willamette River watershed comprises an area of about 11,300 square miles, roughly rectangular, lying south of the Columbia River between the Coast Range and the Cascades. Most of the drainage area is mountainous and forest covered with settlement restricted largely to the lower elevation of the Willamette Valley proper. Total population of the area in incorporated cities and towns is about 420,000, which includes Portland (302,000) located at the northern end of the valley at the junction of the Willamette with the Columbia River. About 64 per cent of the entire population of the state lives in this area, which includes the towns of Salem, Eugene and Corvallis.

The territory of the headwaters of the Willamette River and its branches provides steep slopes and rapid fall for the streams, but the populated region is comparatively flat with corresponding sluggish streamflow for industrial purposes and recreation, constituting the summer playground for a large part of the state's population and thousands of visiting tourists. The stream also forms one of the most important spawning grounds for salmon and other game fish.

The ability of modern sanitary engineering to use a grossly polluted stream as the source of a safe and wholesome public water supply was recognized by the board. However, Oregon has abundant sources which will always yield practically pure water making it unnecessary to use the Willamette even though it was freed from pollution. Salem is the only city now using the river as a source of supply and has already voted bonds to provide water from a mountain stream.

Strictly seasonal precipitation, including a three-month period each year without rainfall, results in seriously reducing the summer flow of the main stream and drying up some of the smaller branches. The fact that this period coincides with the recreational months adds to the problem.

Contamination—A review of the sewage facilities in the 65 municipalities, totaling 418,000 population, as outlined in the report, shows that 34 of the smaller towns are without existing sewer systems; 21 communities have combined systems, and 10 have separate systems. Sewer outfalls into the Willamette River or its branches aggregate 150 from these municipalities without considering smaller unincorporated areas and some institutions. None of the cities with populations exceeding 5,000 has any kind of sewage-treatment plants. Among the smaller towns the present treatment facilities consist of nine communities (average population 1,300) with septic tanks, one (Forest Grove) with a purification tank and separate sludge-digestion plant, and one (Woodburn) using septic tank with contact beds.

Pollution from industrial waste includes the discharge from pulp and paper mills, canneries, creameries, two woolen mills and a few other commercial establishments. The discharge of sulphite waste from the pulp and paper mills located in five of the valley towns results in a pollution which, based on the oxygen demand for stabilization, is estimated to be equivalent to the domestic sewage from a population of nearly 600,000. The particular problem relative to the wastes from the 25 canneries in the valley results from the fact that the operating season coincides closely with the low-water flow and recreational months. The sewage-disposal problem of the Willamette River is concerned principally with the summer and fall seasons, May to October. During the remainder of the year the water supply is ample for dilution, industrial wastes are less, and recreation is unimportant.

Program Recommended—The cleaning up of the Willamette River was accepted by the board as a relative term in the statement that, "Considering a general program of stream-cleansing, it should be understood that no absurdly impossible perfection is intended and that practical considerations of cost and feasibility are a definite part of the fundamental assumptions." As the basis of recommendation, the program as presented by the board "will result in a clean river, in a practical sense, without placing an undue burden upon the individuals, municipalities and industries of the valley." After discussing at some length the general principles of disposal of sewage by dilution, its possibilities and limitations, the board outlined the immediate program that is considered to effect the following results in the improvement of the river.

1. All sewage discharged into watercourses that provide dilution less than 7 cu.ft. per sec. per 1,000 population contributing will be passed through complete treatment plants before discharge into the stream, or the effluent from primary treatment plants will be so heavily chlorinated as to insure its complete disinfection.

2. Complete treatment and disinfection of effluent will be provided for all sewage discharged into streams used extensively for swimming or as playgrounds for children.

3. Treatment will be provided for sewage and industrial wastes discharged into streams having adequate dilution, so that

(*a*) No sludge banks will be formed.
(*b*) No local nuisance will be created.
(*c*) No unsightly floating substance will be delivered to the stream.
(*d*) Under no combination of circumstances will there be an exhaustion of the dissolved oxygen content of the stream to such extent as to become deleterious to the highest forms of fish life.
(*e*) No primary treatment installation will be made except with due consideration to possible necessity for further sewage treatment at a later date when and if the valley develops and popular sensibilities demand more thorough treatment of its sewage.

Individual recommendations for many of the valley municipalities are included in the report based on study and inspection by the board, although in many cases definite recommendations are withheld pending more detailed study. New sewer systems are advised for ten towns, and extensions of existing systems are recommended for another half-dozen communities. For Portland, Salem, Eugene, Corvallis, Oregon City and Albany (includes every city in the valley of more than 5,000 population) the report definitely recommends disposal works that include (1) intercepting sewers, (2) pumping plants and (3) primary treatment. In addition to these plants at the six larger communities, intercepting sewers were recommended for six smaller towns, thirteen others need pumping plants, and primary treatment was recommended for an additional 28. On the question of the necessity for final treatment, the board deferred judgment pending further study for most cases but definitely recommended such treatment for twelve communities. Out of the 65 communities studied no improvements in the existing sewerage system were recommended for sixteen.

The special problem involved with the treatment of industrial waste was handled in a preliminary manner at special conferences between the board and representatives of the industries. A meeting with the pulp and paper interests resulted in a program for a qualitative and quantitative survey of the problem with a working budget subscribed by all interests. A similar conference with the canning industry resulted in the provision of a technical committee to assemble data, and the board's conclusion is that this problem can be reduced by a large degree without prohibitive expense.

As an appendix to the report the board prepared an excellent résumé of present-day sewage treatment, explaining the various terms and outlining the results obtained in language for the layman reader of the report.

In addition, the report also contains an outline of the three methods by which the cost of sewerage improvements can be paid in accordance with the present laws of the state of Oregon. Features of (1) general obligation taxation, (2) special benefit district assessment and (3) sewer service charge as authorized by a law passed in the 1933 legislature are outlined. Relative to the feasibility of financing for these improvements, the board closes with the significant statement:

"Under current conditions, federal financing is practically the only recourse for sewage and other municipal improvements. So long as the obligation is legal and the project worthy, the Public Works Administration is apparently not concerned with the form of obligation. If at some future time private financing again be sought, bonds involving general tax obligation of the city will be found more salable and will command the lowest interest rates. Special benefit bonds carry higher rates, although the Oregon Bancroft bonds involve a general obligation, and therefore are quite salable. Bonds backed only by utilities and their revenues will involve much higher rates of interest and will have a very restricted market. It is therefore probable that, for sewerage improvements, municipalities will prefer general tax obligation bonds, even though they expect to collect from service revenues sums adequate to avoid the necessity of ever levying a tax to pay them."

Answers to Questions on PWA Loan Procedure

Types of municipal projects eligible for loans under the Recovery Act, extent of grants and loans under the act, effect of its labor provisions on municipal construction and other questions frequently raised are authoritatively answered

MANY QUESTIONS as to the eligibility of municipal projects for financing under Title II of the Recovery Act, how the loan and grant provisions of the act are to be applied to such projects and how its labor provisions will affect municipal construction have been put to the state engineers of the Public Works Administration and to others concerned with the administration of the act. As neither the act itself nor the rules prescribed by the president of its administration (Circular No. 1, Federal Emergency Administration of Public Works) are specific on many of these questions, an attempt has been made in the following set of questions and answers to clarify many of the issues raised. The questions have been so phrased as to cover as many as possible of the questions raised frequently. The answers are compiled from official references or after consultation with PWA officials. They may be regarded as authoritative but in no way commit the PWA.

Q. Must complete detailed plans and specifications be ready before project can be passed upon by (*a*) state engineer, (*b*) state advisory board, (*c*) Washington?

A. No. Tentative allotment will be made on *prima facie* showing that project is desirable, is satisfactory from an engineering standpoint and can be financed under the law, such allotment to lapse unless a complete presentation by applicant follows in time to permit execution of final contract within 30 days. The *prima facie* showing must be sufficiently comprehensive to permit intelligent study of the project by the state organization and the staff at headquarters.

Q. Must financing be complete for above consideration?

A. The method of financing proposed by applicant must be fully outlined; it need not be completed.

Q. Will competing utilities be approved? (*a*) Light and power plants, (*b*) waterworks?

A. Such applications will be considered on their merits by PWA. Both President Roosevelt and Secretary Ickes, Administrator of Public Works, have stated that municipal electric projects will rereceive sympathetic consideration.

Q. What is the maximum amount of the outright grant by the federal government? Will any 100 per cent grants be made?

A. Thirty per cent of the cost of labor and material; the remainder of the total cost of the project will be loaned or it may be obtained from sources other than the PWA.

Q. Will a 30 per cent grant be allowed in every case? If not, what are the considerations that will determine the amount?

A. In the vast majority of cases, the full amount of the grant will be made.

Q. What character of projects will be preferred as to a grant?

A. Preference is given to (1) waterworks and (2) sewer projects not involving an undue burden of debt and necessary to the health and convenience of the community; (3) sewage-disposal projects sufficiently comprehensive to render a river or lake system, used by many communities, safe as a water supply; (4) other sewage-disposal projects; and (5) other "regenerative" projects, such as highways, bridges, tunnels and electrical transmission lines into territory not now served, that tend to stimulate further projects and open new territory for homes and industry.

Q. Is a grant contingent upon other funds being raised? Can grants covering a group of projects be lumped to complete the first?

A. The project must be completely financed. In all but very exceptional cases, the grant will not be paid over until the project nears completion, as the amount depends upon the cost of labor and materials. Pooling of grants is not permissible.

Q. Is the rate on loans to municipalities, park, school, levee, drainage and sanitary districts to be uniform at 4 per cent?

A. The 4 per cent rate is uniform on projects of public bodies. The United States will bid par and accrued interest on bonds. If such bonds bear interest at more than 4 per cent, the difference will be refunded.

Q. Is there a uniform rate of amortization?

A. Loans must be annually amortized over the period of useful life of the project, but not to exceed 30 years, except in the case of projects that obviously have a longer life when the limit is 50 years.

Q. Will the following securities be eligible? Special assessment bonds, tax-anticipation warrants, water revenue and sewer revenue bonds? Will all be accepted on the same basis?

A. On non-revenue-producing projects, general obligation bonds are preferred. On revenue-producing projects, such as waterworks, electric-light plants, etc., revenue bonds will be acceptable if auauthorized by state law. The purchase of special assessment bonds will be considered, if authorized by state law. The PWA has expressed no opinion on the acceptability of tax-anticipation warrants.

Q. Will the PWA make 100 per cent loans on self-liquidating projects to municipalities? (The answer would appear to be self-evident, but the law does not cover this case.)

A. Yes.

Q. What public buildings are eligible for loans? (*a*) city hall; (*b*) municipal garage; (*c*) public library; (*d*) public hospitals; (*e*) public children's or old people's homes; (*f*) schools; (*g*) municipal centers; (*h*) markets; (*i*) auditoriums; (*j*) park buildings, such as shelters, swimming pools, etc.

A. All are eligible for loans, but every project will be considered on its individual merits.

Q. Will favorable consideration be given to the following:
Repair of public buildings *A.* Yes.
Resurfacing and repair of city streets?
A. Yes, for *major* repair work.
Extension of city recreational facilities?
A. Yes.

Q. What are the conditions under which (*a*) the federal government will undertake construction of a project and lease it to the applicant? (*b*) Must the applicant's bonding power be exhausted? (*c*) On what terms will improvements be sold ultimately to the municipality? (*d*) Must 100 per cent of cost price be paid for such improvements?

A. (*a*) Generally when there are legal limitations on the power of the applicant to borrow or when its borrowing power is exhausted, but (*b*) bonding power need not necessarily be exhausted. To what extent this is a condition precedent to exercise of the Administrator's leasing powers depends upon the nature of the project. (*c*) The United States will hold title to the property until paid for its outlay (less the grant, if made) through rental or payment of cost. This will be spread over a period determined by the circumstances in each case.

Q. Is there any policy limiting the number or aggregate cost of all projects approved for any one state or municipality? In other words, is there a definite allotment for a state or city?

A. No.

Q. What is the labor and wage policy on projects financed by the Public Works Administration? Will the "prevailing wages," which, in many places, is the union wage, be required on work outside of the large centers of population?

A. The law specifies a 30-hour week so far as practicable and feasible on all construction projects financed by PWA. This includes both federal and nonfederal projects, but the 30-hour requirement has been construed by PWA to permit the hours of work provided for the several classes of labor in NRA codes, but any class not covered by a code may work only 30 hours a week, with the following exceptions: (1) Time lost because of weather or any other avoidable delays may be made up in subsequent weeks; (2) 130 hours a month may be substituted for the 30-hour week in localities where a sufficient amount of labor is not available in the immediate vicinity; (3) a 40-hour week of 8-hour days is permissible on work at points so remote and inaccessible that camps are necessary for all labor employed, and if so determined by the PWA state engineer prior to advertisement. Schedules will be furnished state advisory boards, and state engineers setting forth the minimum wages established by agreement between the PWA and the building-trade unions for skilled and unskilled labor (*ENR*, Aug. 24, 1933). The minimum rates will not apply if prevailing rates on April 30, 1933, prescribed under collective agreements or understandings between organized labor and employers, are higher. In either case the wage rates must be written into all contracts and subcontracts, also in advertisements for bids and in all proposals of bids submitted, including those of subcontractors. Prevailing union rates in any district, such as "the large centers of population" referred to in the question above, will not be blanketed throughout the zone. Only where union rates have been paid within recent months will they apply in lieu of the minimum rates set forth in the agreement of the unions with PWA. All wage disputes arising under contracts financed by the PWA will be heard by a board of labor review appointed by the President, and its decision will be binding upon all parties.

Q. What is the policy on recruiting labor?

A. Contractors may secure highly skilled or organized labor through union locals. If locals fail to furnish such workers within 48 hours, they must be obtained through local re-employment agencies designated by the U.S. Employment Service. As far as practicable all other labor must be selected from lists submitted by the re-employment agencies.

California Adds 6,800 Miles to State Highway System

Statute places important county roads under state control and provides direct aid to municipalities from state gas tax—Allocation of funds for primary and secondary routes made more flexible

THE CALIFORNIA state highway system was increased by 6,800 miles on Aug. 22 when new legislation became effective, designed to relieve the burden of local road financing and make available direct aid for municipalities. Mileage in the enlarged state system now totals 13,250 in addition to about 900 miles of streets in municipalities taken over to provide connecting links. The legislation followed closely the recommendation of the highway commission both as to the selection of the mileage to be included and the readjustment in the allocation of the gas-tax funds. For the present the state will take over maintenance work on the existing routes, leaving future study to determine advisable changes.

Equitable use of gas tax funds

Backed by both the state highway commission, semi-public organizations and municipalities, the new highway legislation was planned to provide a more equitable use of gas-tax funds in the construction and maintenance of a complete state highway system, relieve the road-tax burden from counties and municipalities and equalize the state highway mileage between the north and south half of the state. Important provisions in the new law include: (1) 1c. of the gas tax revenue (3c. state tax) is to be used for general highway administration and maintenance of the state highway system; (2) 1c. is to be used for the primary highway system in accordance with the percentage of highways in the two halves of the state; (3) the other 1c. is to be expended on the secondary highways of the state system. The act also provides greater flexibility in the distribution of funds between the primary or secondary system in accordance with existing needs. The principal feature insuring this flexibility provides that if, in the opinion of the highway commission, the funds allocated by the law for either the primary or the secondary sytem in either half of the state are insufficient for maintenance and construction, the commision can divert up to 50 per cent of the funds from either type of highway to the other within the same half of the state.

One of the important features of the act is the further provision that "The Department of Public Works shall annually expend from the state highway fund an amount equal to ¼c. per gallon of gas tax . . . within the incorporated cities and cities organized under freeholder charters, and such expenditures shall be made within each city or city and county within the state in proportion to the total population in each city or city and county bears to the total population in all such cities in this state." The law provides that this money shall be expended first for the maintenance and improvement of state highways within the cities, but after these have been brought to state highway standards the surplus can be used in such cities for other streets of major importance. Further, the work can be carried out by the city if the state is satisfied with the equipment and operation of the city department.

In reference to the location of state highways in and through municipalities, the law provides: "Sec. 5—The California Highway Commission shall have jurisdiction and authority as provided in this section with respect to any state highway lying within any municipality as specifically described by law, also with respect to a state highway, the natural course of which runs or passes into or through any municipality or contiguous municipalities. Unless any such route or routes within a municipality is specifically described by law it shall be the duty of the highway commission to designate and to determine the location of connecting portions either through or around the municipality as the commission may determine will be of the greatest benefit to through traffic, and the said commission shall determine such connecting portions with respect to all state highways, the natural course of which runs or passes into or through any municipality."

On Aug. 22 the highway department took over the jurisdiction of the 6,800 miles of new highway system as provided in the act. This includes 5,873 miles outside of incorporated cities and 912 miles inside cities subject to correction following a more complete study of the existing routes. Maintenance operations will be carried forward on the available traversable routes as now designated pending further study by the state for determination of the exact route for permanent maintenance. This maintenance work is limited to the 1c. of the gas-tax fund. Roads and streets taken over in accordance with the new act are in a variable condition of adequacy for the existing traffic, and their improvement will be accomplished as funds become available. For the next two years maintenance only can be provided on the mileage outside of the incorporated cities.

Cooperation with cities

Within incorporated cities the funds provided by the law will be allocated, the law providing that this money may be spent in cooperative projects with municipalitiles. Based on the gasoline consumption in 1932, each city is estimated to receive about 68c. per unit of population for the next twelve-month period. The funds become available in quarterly periods, which does not permit the immediate undertaking of major improvements by municipalities until the allocated funds become available and accumulate. The procedure to be followed by municipalities requires the formulation of administrative policies that have not yet been worked out.

The new California highway program is carried out under the jurisdiction of the Department of Public Works, division of highways, under the immediate direction of C. H. Purcell, state highway engineer.

Letters to the Editor

Corrosion and Brittleness in Cold-Driven Rivets

Sir—In a letter in your issue of June 15, 1933, F. G. Thorn, Jr., presents an interesting article on the superiority of cold-driven rivets. While I have no intention of detracting from the facts that have been presented, there is an important feature to be considered in connection with the use of cold-driven rivets that are to be subjected to more or less corrosive elements, as it has been found in oil-refinery practice that the heads of annealed rivets driven cold with the ordinary pneumatic hand hammers are often much more rapidly attacked by corrosion than those that are formed hot. This is due to the minute fractures of the metal in the rivet heads from the cold-working of the metal in forming the rivet heads, often referred to as crystallization, metal fatigue, embrittlement, etc.

As an extreme case, a large cold-formed rivet head that has been overdriven can often be knocked completely off by a sidewise blow of a light hammer. Such cold-driven rivets may suffer no loss in shear strength, as the shank of the rivet has not suffered the severe strains from cold-driving that the head of the rivet has in being formed cold. This applies, as stated above, to moderate-size rivets that are driven cold by the ordinary pneumatic hammer striking a rapid succession of blows and may not apply so much to the large rivets driven by a single compression machine. The practice of using cold-driven rivets should therefore be exercised with due caution.

H. J. WRIGHT,
Chief Engineer, Paulsboro, N. J., Refinery.
Socony-Vacuum Corp.

Paulsboro, N. J.
Aug. 21, 1933.

Securing Business at the Right Price

Sir—Referring to the article by J. L. Harrison on securing business at the right price (*ENR*, Aug. 3, 1933, p. 129) comment is necessary. The principles advocated in this article are not only wrong in general but are dangerous advice to engineers engaged in estimating for contractors.

His statement that, "The right price is the best price the market affords" is so erroneous that it will not, we hope, be taken seriously by any contractor, whether operating on roads or other forms of construction work.

If the author will investigate the estimating policy of any successful contractor (a contractor in business for a considerable period, competent, reliable and financially strong), he will find estimates are fully made, followed to their ultimate conclusions, and a definite probable cost is established. The inevitable result of discounting this cost, to meet figures made by failing, incompetent or financially irresponsible contractors, will be to join their ranks.

The successful contractor is now standing by, picking up profitable work here and there, and with his capital unimpaired. He is actively engaged in figuring work, keeping well in touch with market conditions and trends. When the time is right and when price-cutting, discounting subcontract and material bids, peddling, robbing Peter to pay Paul and other such subterfuges have run their course, he will come again to the front, just as he always has in the past.

Chicago, Ill.,
Aug. 30, 1933.

R. F. KIRKMAN,
J. W. Snyder Co.,
General Contractors.

Handling Cement at Madden Dam

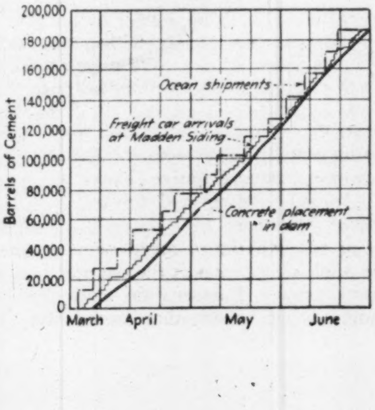
Sir—In the article "Demoistured Air Aids Madden Dam Cement," published in your issue of July 6, 1933, it was inadvertently stated that in the hauling each truck averaged fifteen loads in twelve hours. This should read "fifteen loads in 24 hours."

The schedule has been further modified for an eight-hour shift by increasing the number of trucks from three to four, each truck making four round trips in seven hours, with one hour for servicing and refueling. The reduced speed and regular attention have proved more economical by lowering the maintenance and repair expenses.

The truck capacities given in the illustration are volume ratings on the basis of 4 cu.ft. per bbl. and allow for "fluffing." Based on weight, the average load per truck has been raised since the article was written from 54 bbl. by improved filling procedure to 62.9 bbl.

The accompanying chart shows how the cement-handling system has operated during three of the heaviest months of the concreting season. Deliveries were scheduled at the rate of 12,500 to 15,000 bbl. per week. Unloading from the ship's hold was, of course, maintained at the maximum possible rate, the sacks being manually stacked on pallets, 40 per pallet, and hoisted out on the dock. The pallets have high sills to permit the lift-arm of industrial electric hoisting trucks to extend under them; their tops extend beyond the sills to form ledges for the rope slings. In transit the trucks elevate the pallets and set them into box-cars. During switching of cars and similar delays the loaded pallets are stored on the floor of the dock for car loading after the ship has left. In this manner the rate of cement arrivals at Madden Siding is ironed out to coincide almost completely with the rate of consumption at the dam. The equipment has functioned consistently, car demurrage has been less than anticipated, and the two silos have provided enough reserve capacity so that only three days have been lost by shortage of cement during these three months.

Progress of cement deliveries and concrete placing to July 1 at Madden Dam in the Panama Canal Zone.



A. J. ACKERMAN.

Pedro Miguel, C. Z.,
July 13, 1933.

Bed-Load Drift Across Current

Sir—In reading the articles recently published in *Engineering News-Record* on "New Plans for the Mississippi," I was particularly interested in the one of July 13, 1933, and the discussion of Fig. 2, p. 41. It seems there is a drift of the bed-load sand away from the concave side of the channel curves, this drift being across or at an angle with the direction of the movement of the water at that point. Quoting the article, "To account for this apparent anomaly, the theory has been advanced that material transported along the bed of a stream tends to move across the section to zones of lower velocity." If the following remarks throw some light on the anomaly, I shall be much pleased.

Assayers of gold and silver utilize a similar tendency within the small confines of a 1-in. crucible (porcelain). In parting a low-grade bead of gold and silver alloy, the silver goes into solution, but the gold is left in the form of a brown powder scattered about on the bottom of the crucible. After decanting the solution and washing the gold, the crucible is filled about half full of water and given a circular motion to get the water in a whirl. The brown particles are in suspension, whirling with the water. The crucible is now set on the table, the agitation subsides, but the water continues to whirl, the particles begin to settle, and as they touch the bottom they immediately assume a spiral course to the center of the crucible. Here they form a huddle, slightly cohere and are ready for further manipulation.

This action can be confirmed in a teacup with a little water and a pinch of sand. It reproduces on a minute scale what takes place at the bottom of a bending river channel. In the crucible we have material moving at an angle with the direction of the flow of the currents by which it is transported. And here we have the "point of focus" corresponding to that mentioned in the article of July 13.

Why do these heavy particles of gold slide to the center against the centrifugal force tending to throw them to the periphery?

When water is standing, the force of gravity creates a pressure that increases from the surface toward the bottom. Submerged bodies are subject to a force exerted in the direction of least pressure and equal to the weight of the water displaced. When the water is in a whirl, there is developed by centrifugal force a horizontal pressure that increases from the center toward the periphery, so that any submerged body is subject to a force exerted in the direction of least horizontal pressure and about equal to a centrifugal force set up by a volume of water equal to that of the body, and moving under the same conditions as to speed, depth and distance from the center. When the body is in suspension, its centrifugal force counteracts the horizontal pressure of the water, but when it drags on the bottom its centrifugal force becomes practically nil and it moves under the horizontal water pressure toward the center.

The horizontal pressure set up by the centrifugal force is the horizontal component of the total pressure, which acts in a direction at right angles to the inclined water surface. The lateral inclinations of the river surfaces are caused by the same lateral horizontal forces set up by the energy of the flowing stream that drive the bed loads laterally. They may be caused by centrifugal force, permanent waves or other hydraulic action.

One would expect that permanent waves would be thrown up in such a bend as that shown in Fig. 2. It will be observed that the two 1 per cent bars, the lower end of the 87 per cent bar (where it may have begun to form) and the 5 per cent bar are spaced at equal distances. Is this a coincidence or did they form at the troughs of permanent waves?

R. H. Britt,
City Engineer.

Rockland, Me.,
Aug. 2, 1933.

Wood Borers Destroy Piles

Sir—Concerning the article by C. A. P. Turner on wood borers (*ENR*, Aug. 10, p. 159), his description of the way in which the insects caused this unusual damage is very interesting, but I believe the influence of decay should not be ignored. The conditions surrounding these pilings should have been favorable to decay, and I am inclined to believe that failure would have resulted ultimately from decay if the insects had not attacked. It is unfortunate that none of the insects were secured for identification by entomologists.

I am not entirely in agreement with Mr. Turner's suggested method of protection by sealing the tops of the piles with concrete. That method would probably be quite effective against the insects he describes, but pile heads above the permanent water table would still be exposed to the danger of decay and possibly also to termites. Covering wood with concrete does not insure it against decay, although it may sometimes reduce the decay hazard. Slight cracks in concrete are all that termites need for their entrance.

When piling is to be used to extend above the permanent water level, the surest way to protect it both from decay and insects is to have it thoroughly pressure-treated with coal-tar creosote. When untreated wood is exposed at the cut-off after driving, the cut surface should be given at least two coats of hot coal-tar creosote, then a coat of asphalt or pitch, and finally a layer of roofing felt or a metal cap. This protection is needed to remove the possibility of decay getting into the untreated center of the pile.

Foundation piling cut off below the permanent water level, of course, needs no protection except in salt water.

Geo. M. Hunt,
U. S. Forest Products Laboratory.

Madison, Wis.,
Aug. 15, 1933.

Banking Highway Curves

Sir—In a recent publication by an authority on the subject of automobile accidents a statement is made that "The accidents on curves are so serious in their consequences because speed is usually the main factor in the causes of such accidents." As bearing on this statement, the accidents on highway curves show a greater proportion of deaths to the number of accidents than any other road location with the exception of railroad crossings. It is a matter of record that nearly 9,000 have been killed and over 100,000 injured on highway curves during the past three years.

The universal practice of superelevating the outside rail of railroad curves, which has an important bearing on the safety of high-speed operation, has not been followed in many instances by the equivalent banking of highway curves. A single fatality on a railroad, which might be attributed to improper superelevation, would unquestionably lead to an investigation to determine who was responsible. Fortunately for those who travel by rail, the flat or negative superelevation of railroad curves is something unheard of. Unfortunately for the motorist, there are altogether too many curves on which the surfaces are flat or, even worse, have negative banking—that is, sloping downward toward the outside of the curve.

The proper banking of curves serves a double purpose. It makes the car much easier to steer and lessens the liability of skidding. On a curve that is properly banked a car will almost steer itself. On a curve that is flat and particularly if it has negative banking, the centrifugal force so reacts on the steering gear that it tends to turn the car off the road toward the outside of the curve. The higher the speed the more tricky and dangerous is this effect on the steering.

The principles involved and the rules for the proper construction of highway curves are so simple and well known to engineers that a reference to them seems hardly necessary. A brief mention, however, of the forces that are neutralized by banking and a rule for the banking of curves may not be out of place.

The centrifugal force on a curve—that is, the force tending to throw the car toward the outside of the road as measured in per cent of the weight—is

$$6.688 \times \frac{\text{m.p.h.}^2}{\text{radius in feet}}$$

As an illustration, at 50 m.p.h. on a curve with a radius of 500 ft., a car weighing 4,000 lb. would be subjected to a force of 1,338 lb. which, on a flat curve, would appreciably affect both the steering and the tendency to skid. If the curve had negative banking, the effect would be even worse.

It is quite unnecessary to bank curves sufficiently to provide full compensation for the centrifugal force, as the friction of the tires on the pavement serves to hold the car unless the force is so great as to cause skidding. The point is that proper banking provides a much greater margin of safety.

The rule for superelevation in inches per foot for full compensation is

$$0.8 \times \frac{\text{m.p.h.}^2}{\text{radius in feet}}$$

or, if the curve is measured in degrees —deg. curve × m.p.h.^{2} × .00014.

Where conditions will permit, it would seem reasonable to bank small-radius curves for at least 10 m.p.h., intermediate curves for 20 m.p.h., and curves of larger radius for at least 30 m.p.h. Curves with a flat surface should be an exception, and only for the most compelling reasons should a curve have negative banking. There are doubtless many curves already constructed which would be much safer if given the proper banking by resurfacing the old pavement.

Presumably instructions for the proper banking of curves are a part of every highway specification, but if so there is a lack of adequate supervision. There are laws relating to the speed and inspection of automobiles, and unless the engineering instructions are more closely followed there is an equally good reason for legislative action relating to the inspection of curves.

W. B. Potter.

Schenectady, N. Y.,
Aug. 14, 1933.

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A Realistic Policy

THE HOUSING division of PWA is getting off to a splendid start. Loans totaling over $35,000,000 have been approved for different cities, and others are pending. Such results are doubly gratifying because they are the outcome of a definite, well-conceived policy. The most significant characteristic of this policy is that it is realistic. Thus, while it recognizes the necessity and social desirability of large-scale slum-clearance housing, it also takes account of the fact that time is required to get many projects of this type under way. And time lost is quickly translated into unemployment gains. Accordingly, it is the stated policy of the PWA housing division to favor slum-clearance housing but to compromise in favor of apartment house projects on individual plots, if these are ready to go ahead. It does not detract from the praise due such a policy to point out that it is the only logical one to be followed. It assures an end to some of the dilatory methods that have frustrated housing loans previously, because it is planned to secure immediate action. At the same time it keeps clearly in view the major objective of decent and modern housing for the lower-income groups.

Getting up to Speed

DEFINITE indications come from Washington that the public-works program is accelerating rapidly and will soon be moving at full speed ahead. One sign is the White House assurance that the unallocated remainder of the public-works fund will go to self-sustaining public works, which means municipal projects. A second is the fact that the first local-project loans other than R.F.C. holdovers were approved during the past fortnight. A third is the announcement of the Public Works Administration on Sept. 6 that projects may be approved on preliminary application, before the full data specified by PWA Circular 2 are furnished. Under this regulation municipal and state projects can get under way much faster and in larger numbers than was possible hitherto—a development that should bring encouragement to all who look for the start of a considerable amount of local public work before winter. The Public Works Board's action should spur all who are working on plans for municipal and state projects to renewed effort. The PWA has managed to lose two months since the Recovery Act was passed in June, and even now the machinery for handling applications for loans for municipal projects from the source to Washington has not got to functioning smoothly and rapidly. But the desire to make up for lost time now is fully evident in Washington, and as a consequence much of the future responsibility for getting work under way has been passed to the cities and states. It is a challenge that should be answered with preliminary applications for funds from every corner of the country.

Toward a United Industry

MANY of those who are concerned over the lack of cohesion between the many elements of the construction industry have hoped to find a centralizing influence in the codes required of all industry under the National Industrial Recovery Act. Special significance, therefore, attaches to the public hearings on the basic construction code and upon some of the supplemental codes that began in Washington last week, because these hearings were expected to indicate how closely the industry can be knit together. Viewed from this side the developments revealed by the hearings are distinctly encouraging; many elements have been brought to a new recognition of the problems of other branches of the industry. A certain amount of discord was in evidence, however. Contractors on building work in large cities where labor is highly unionized, as represented by the Building Trades Employers Associations, are quite out of sympathy with the plan to put all construction under one basic code and all general contractors under a sub-code. They fear among other things disruption of the existing wage-rate schedules and enforced abandonment of their boards of mediation, by which disputes over labor conditions are settled, and the substitution of a new and untried plan under the code system. The charge was made also that a code submitted by the Building Trades Employers Association had been buried in order to keep it from coming up for consideration at the public hearings. Some of the fears expressed appear to be without foundation, but others present serious problems. All animosities that stand in the way of cooperation should be recognized and thrown out, or else those who cannot forget them should be supplanted in the negotiations. A united industry cannot be brought about except through the wholehearted cooperation of all its diverse elements in working out the basic code for the industry and the major supplemental codes.

Comprehensive Stream Cleansing

FROM a section of the country where abundance of water supply precludes the strictly utilitarian demand for sewage treatment comes a program based on an equally valid desire. The Oregon communities in the Willamette Valley, which contains two-thirds of the state's population, have acknowledged the frequent—but too often unrecognized—public demand for the abatement of stream pollution on the ground of restoring recreational values. Unlike many other communities faced with a similar problem, however, the streams in this region are subject to long periods of extremely low water in the summer and fall, so that the intensity of pollution is at its highest just when the recreation use of the stream is most important. Prompted by the advantages of the public-works program, therefore, a survey has been made to provide the basis for a coordinated plan of remedial action, realizing the fruitlessness of individual effort by the many cities and towns in a program of river cleansing. The engineering board has made a practical approach and has outlined a feasible plan as reviewed elsewhere in this issue. Recognizing the impracticability of attempting to restore a stream to its original purity, the report submitted by this board recommends primary treatment only, to remove unsightliness and enough of the oxygen demand to permit the return of normal recreational value. It is to be hoped that the individual projects outlined can be speedily undertaken and that the example set by the program will be studied elsewhere.

Not in the Public Interest

MATTERS of more than ordinary moment are involved in one event of the public-works campaign that has received little attention despite its intimate relation to the current recovery efforts as well as to national development policy in general. This event is the allocation of some $22 millions for constructing the Casper-Alcova irrigation project in Wyoming and the associated water-storage and power plant at Seminoe, on the North Platte River. The conditions of the project are such as to raise grave question whether the allocation is in the public interest.

Briefly outlined, the project is designed to supply some 66,000 acres of land with water for crop-raising. It is located in a region of rough topography, poor soil and unfavorable climate. The irrigation works will cost nearly $250 per acre to build, though the government's agricultural experts found that the farmers will be able to pay annually only $2 per acre in rental and amortization. At this rate farming is obviously unprofitable. On the other hand, the power plant is expected to return a handsome yearly income if the power charges are made high enough, as is contemplated. The official plan is to use this profit to offset part of the deficit on the farming operations.

With respect to the recovery program, the project gives no promise of early employment, and so is likely to weaken rather than strengthen the recovery drive. The public-works section of the Recovery Act was enacted to provide quick reemployment, and was not designed to furnish a means for initiating construction of projects whose beginning must be long deferred. The Casper-Alcova development is of the latter kind. It is still in the early, raw stages of planning—and the preparation of working plans for a large irrigation project in difficult country is a task of many months. Moreover, it cannot begin until lengthy and tedious negotiations and legal proceedings are completed; among other things that have to be done before work can start under the Reclamation law, contracts for use of the water and payment for water and canals must be arranged with hundreds of private owners, a difficult and doubtful proceeding under the circumstances of this enterprise.

Inasmuch as the project will not help to solve the emergency unemployment problem and so fails to answer the purpose which the Recovery Act aims to serve, the allocation runs counter to the plain intent of the Act. It is a wasteful use of the emergency fund, and should therefore be reconsidered and revoked. If the project has merit on other than emergency employment grounds, it may safely await later government action.

Quite aside from the time factor, the $3,300,000,000 public-works program has from the beginning been predicated on sound undertakings. There can be no doubt as to what a sound construction undertaking is: it is one in which each dollar paid out creates at least a dollar of value. The Casper project falls millions of dollars short of meeting this test, since the expenditure of $250 per acre will create a value of barely $100 per acre—a high appraisal on an annual rental of $2. This is anything but sound expenditure. A project of such character has no place in the emergency construction program.

Taking a longer view, the relation of the project to national development policy attracts attention, for its economic aspects naturally raise the question why the government should undertake the project at all, especially in these days of disastrous agricultural surpluses. The answer may be found in several reasons offered by government representatives. One is that the city of Casper, threatened by the decline of oil and stock activities, needs a new source of business; another, that the grazing industry of the region requires the support of an agricultural area to supply winter feed, which otherwise must be shipped in from a distance. A third reason lies in the claim that federal development of one or more irrigation projects in Wyoming was promised by government officials many years ago, that on the strength of these promises the state allowed the government to build Pathfinder Reservoir, that the Pathfinder water was thereupon largely diverted to Nebraska lands, and that the Wyoming projects were then abandoned. A fourth reason is that the government's income from Wyoming land sales and oil royalties has totaled twenty to thirty million dollars, which sum, it is urged, is in effect owed to Wyoming; the argument is that to square the account a like sum may properly be spent in the state on irrigation development, even if it be wasteful development.

Whatever merit this reasoning may have, it is significant as expressing in no doubtful manner the purely local-benefit character of the undertaking. To use national funds for local purposes, however, is plain pork-barrel procedure, which is universally and justly condemned. Surely it cannot be accepted as part of a national development policy. Yet the Casper-Alcova precedent threatens to engraft this bad principle on the country's future policy, to the lasting injury of national character as well as the taxpayer's welfare.

The fact that the profit on Seminoe power will absorb some or all of the irrigation losses has also been put forward as a defense of the project. Those who advance this argument do not explain, however, why the efficient use of money to build a power plant should serve as warrant for throwing away money on a farming project that is bankrupt from the start. The government would do better to build the power enterprise alone.

It needs nothing further to indicate that the Casper-Alcova undertaking departs far from the old landmarks of national development, and also from the special principles on which federal reclamation is founded. It threatens to overthrow the long-honored rule that national works must be inherently sound and must be of national rather than local benefit. In its place it tends to set up doctrines of logrolling and ward politics. Further, it challenges the basic principle of reclamation, that irrigation works may be built by the government only if they are profitable and if the beneficiaries agree to repay the cost.

Thus, momentous changes in public policy loom up ahead if the Casper-Alcova allocation is permitted to stand and to establish a precedent. But all things considered, the old principles still appear to be the better. They deserve to be maintained if progressive national development is to continue.

NEWS OF THE WEEK

Public Works Fund Allotments Now Near Half Way Mark

THE $3,300,000,000 public works fund has now been nearly half allotted. Action taken during the past week brings the total allotted to date to $1,431,540,234.

An alloment of $1,850,000 to the Board of Supervisors of Milwaukee county, Wisconsin, for the construction of a sewerage system has been announced by the federal Public Works Administration. This project is the first to have passed all the way through the PWA's decentralized machinery, which has been set up to handle the non-federal projects. The application was approved by the State Engineer of the Public Works Administration, the Wisconsin State Advisory Board and the engineering, financial and legal divisions of the PWA in Washington and the Special Board for Public Works. The allotment includes a grant equal to 30 per cent of the cost of labor and materials employed.

An allotment of $250,000 to the City of Eau Claire, Wis., for the construction of waterworks improvements has been made. Seventy per cent of the allotment will be in the form of a loan on 4½ per cent revenue bonds, payable semi-annually so that the complete loan can be repaid by 1953. The excess over 4 per cent will be refunded. A grant of 30 per cent of the cost of labor and materials is included in the allotment.

Madison, Wis., has been made an allotment of $913,000 for the construction of sewerage works by the Metropolitan Sewerage District of Madison. Included in the allotment was a grant of 30 per cent of the cost of labor and materials, estimated at $281,000. The balance is in the form of a loan secured by general obligation bonds bearing 4 per cent interest, maturing over a period of 30 years. The money will be used for building a sewage disposal plant, outfall sewers and a pumping station.

A further allotment of $135,000 has been made to Madison for sections of storm and sanitary sewerage and for a small bridge. The 30 per cent grant in this case is estimated at $32,400. The portion to be loaned is secured by general obligation 4 per cent, 20 year serial bonds.

Six waterworks get loans

Loans and grants have been approved for waterworks construction in six municipalities, aggregating $224,000. The projects so approved and the amounts involved are as follows:

Montgomery, Ala., deep wells and pumps	**$70,000**
East Brunswick, N. J., distribution system	**60,000**
Petersburg, Ind., filtration plant and pumping station	**50,000**
Northport, Mich., wells, pumps and distribution system	**32,000**
Uniontown, Ala., reservoir and pumps	**6,000**
Warrenton, Ga., deep wells	**6,000**

All of these loans are to be repaid with interest at 4 per cent per annum, payable semi-annually.

A grant of $75,000 has been made to Norwalk, Conn., for improvements to its water system. The total cost of the construction will probably exceed $250,000.

St. Paul, Minn., has been alloted a grant of $87,180 to be used for the construction of a $290,600 street improvement program. This grant will assist in financing improvements of 9 streets. Funds, exclusive of the grant, are now available from the Permanent Improvement Revolving Fund of the city.

Grant only to New Hampshire bridge

A grant of $220,000 to the State of New Hampshire to aid in financing two publicly owned toll bridges has been made. The gross cost of the project is estimated at $1,100,000 and under a state act authority has been given to borrow on bonds and notes up to this amount. Bids

(Continued on page 334)

Maryland Advisory Board Approves Seven Projects

The Maryland State Advisory Board of the PWA has approved seven projects for which funds will be sought from the federal government. The seven projects approved will cost about $1,495,000, toward which the government will be asked to contribute about $448,500 in the form of grants.

The proposed projects are as follows:

New streets and sidewalks at Glen Echo, Md., $13,000.

New school buildings and additions in Prince George's county, $407,000.

Reconstruction work at the Maryland Penitentiary and House of Correction, $250,000.

General sewer improvements at Annapolis, $650,000.

Sewer system improvements at Belair, $125,000.

Water supply system at Clear Spring, $23,000.

Sewer and water supply program for Vienna, $27,000.

Important Changes in Construction Codes Proposed at Hearings in Washington

IMPORTANT changes in the basic code for the construction industry and in some of the supplemental codes already filed with the National Recovery Administration were proposed to the Administration at public hearings held in Washington Sept. 6-8. The most significant changes proposed are in the basic code and in the code for general contractors and for architects, the two principal supplemental codes considered. They relate to hours of work, minimum wages, bid peddling and bidding practices. The codes considered, in addition to the above, were those for master painters, electrical contractors, marble, plumbing and heating, steam heating and piping contractors, cement-gun contractors and building granite contractors. Malcolm Muir, deputy administrator, or Malcolm Pirnie presided at the several sessions.

Construction industry code

The code for the construction industry was filed with the deputy administrator by Stephen F. Voorhees, chairman of the code committee of the Construction League of the United States, and Willard Chevalier, representing the Construction League, outlined to the administrator the importance of the construction industry as affecting the general welfare of the country and emphasized the need for control of its operations through a basic code covering all types of construction with supplemental codes covering the many branches. Col. Chevalier pointed out that the construction industry is second in importance only to agriculture, that in 1929 to service this industry $7,000,000,000 was paid to some 4,500,000 persons out of a total of 48,000,000 gainfully employed. More than half these workers were directly engaged on construction, and the remainder were employed in those professions and industries dependent for their markets on the requirements of construction. He was followed by Mr. Wenglik of the NRA statistical staff, who submitted charts and other information on the relation between general business conditions and the operations of the construction industry, with special reference to urban construction.

Details of code changes

The code as presented called for a maximum average of 35 hours a week during a 6-month calendar period. This the code committee of the Construction League proposed to raise to 40 hours so that the code will read as follows:

> **Employers in the construction industry shall not employ any employee in excess of the maximum average of 40 hours a week during a six-months calendar period, or 48 hours in any week in such period, or 8 hours in any one day, excluding employees engaged in professional, executive, administrative or supervisory work, those engaged in cases of emergency work requiring the protection of life or property, and those establishments employing not more than two persons in towns of less than 2,500 population, which towns are not part of a larger trading area.**

A minor change in the section relating to clerical and office employees also was proposed, making the *maximum average* employment 40 hours in any week. The original draft called for a *maximum* of 40 hours.

Labor objects

Strong objection to the maximum hour and minimum wage provisions of the code was voiced by representatives of organized labor and by representatives of technical men in the employ of architects and engineers. Rather than raise the maximum hours of work to 40 hours per week, organized labor would set the limit at 30 hours except for emergency work.

Continued on page 334

Board of Review of 12 Engineers Set Up by PWA

APPOINTMENT of 12 members of the PWA Technical Board of Review has been announced by Administrator Harold L. Ickes. This group of engineers will consider the qualifications of particularly difficult or controversial projects which are referred to it by the Administration for review. It will also serve in a quasi-judicial capacity and hold open hearings on projects when public opposition develops and such hearings are required. It will further fulfill the functions of a court of appeal on request of the Administration.

Types of projects referred to the board include:

Projects which have been adversely reported on by state boards or by the staff at Washington, which in the opinion of the Deputy Administrator warrant review.

Projects which are protested against by outside parties, groups or other organizations, which protests are, in the opinion of the Deputy Administrator, serious enough to warrant review.

Projects approved in principle by the Deputy Administrator but of such an unusual size or character and involving such difficult questions of engineering, finance or law, that in his opinion warrant review.

Col. Carey H. Brown will serve as acting chairman of the Technical Board of Review. He has been with the PWA since its inception. After a number of years of service in the Corps of Engineers and in engineering work in the District of Columbia, Colonel Brown has recently been executive director of the Civic Improvement Association, Rochester, N. Y.

Members of the board are as follows:

David C. Coyle, New York, N. Y.
Howard P. Emerson, Washington, D. C.
Harrison P. Eddy, Boston, Mass.
Philip W. Henry, New York, N. Y.
Malcolm Pirnie, New York, N. Y.
Frederick H. Fowler, San Francisco, Calif.
W. W. Horner, St. Louis, Mo.
Richard S. Buck, Crozet, Va.
Samuel A. Greeley, Chicago, Ill.
Clarence A. Dykstra, Cincinnati, Ohio.
Irving B. Crosby, Boston, Mass.

◆

State Engineer, PWA Named for Alabama

George Jacob Davis, dean of the college of engineering, University of Alabama, has been appointed engineer for the state advisory committee of public works in Alabama. As engineer for the board, Mr. Davis will pass on plans for all public works projects proposed for the state.

◆

Mississippi River Flood Work To Be Studied by PWA Board

A committee of six prominent citizens and a representative of the Corps of Engineers, U. S. Army, is to be named by Secretary Ickes to make a study of the entire Mississippi system with a view to selecting projects for inclusion in the public works program. Frank Lowden, former Governor of Illinois, has been offered the chairmanship. The other members of the committee are Charles H. Paul, Dayton; Herbert S. Crocker, Denver; Prof. S. M. Woodward, Iowa City; H. Solon Graves, dean of the School of Forestry, Yale University, New Haven, Conn.; and Prof. H. H. Barrows, geographer, University of Chicago.

The Engineer Corps officer will be named by Maj. Gen. Lytle Brown.

Chicago Wants Government To By-Pass River Traffic

Spurred by taunts of inactivity in asking for federal funds in the Middle West, officials of the Chicago Regional Port Commission have developed a $50,000,000 project which would connect the Great Lakes with the inland waterways system through the Sag Channel of the Sanitary District of Chicago. This connection will by-pass the city of Chicago via the Chicago River where the negligible river traffic will always be a nuisance to land traffic so long as bridge openings are permitted. When the Sag improvement is opened all Chicago River bridges can be fixed bridges, thus saving the city more than $5,000,000 annually for land delays, bridge tenders, renewals and maintenance. This is approximately $10 per ton for all the river freight handled. The cost of the Sag improvements is small compared with the $800,000,000 the government has already spent on the two systems it would connect.

It includes widening the Sag channel from 60 ft. to 250 ft. for a distance of 20 miles, $20,000,000; reconstruction of 37 fixed bridges and widening of the Little Calumet, $22,500,000; improving Lake Calumet, $2,500,000; reconstructing 10 bridges from Lockport to Cicero Ave. on the Main Channel, $2,500,000; and widening Grand Calumet from the Sag Canal to Indiana Harbor, $2,500,000.

Major Rufus W. Putnam, executive secretary of the port commission, has the matter under his charge but is enlisting the assistance and cooperation of the agencies involved; Sanitary District, City of Chicago, Cook County and State Highway Division. The project can be ready, if the officials in these bodies cooperate, to submit within a month.

The project would give work for 7,000 men for a 5-year period.

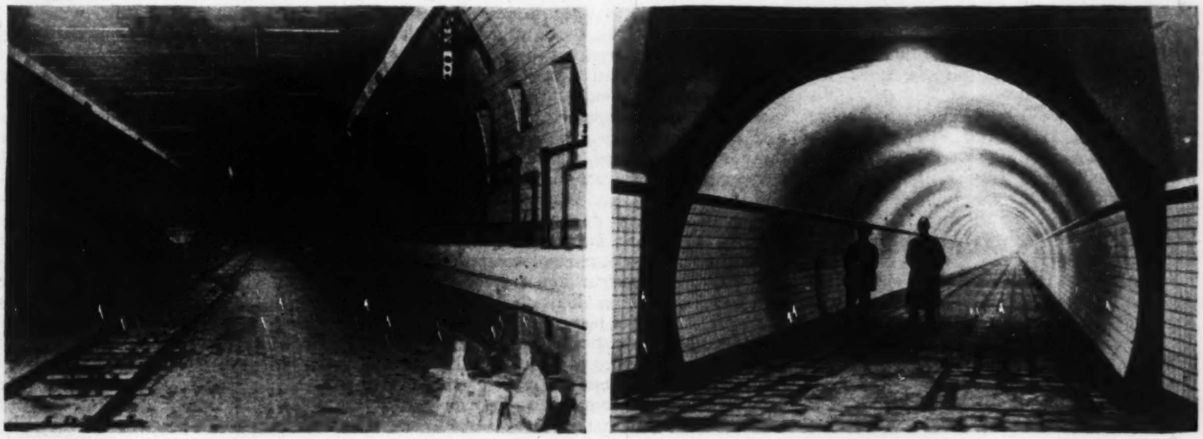
VEHICLE AND PEDESTRIAN TUNNELS OPENED AT ANTWERP

Two tunnels under the Schelde River at Antwerp, Belgium, one for vehicles and one for pedestrians, were opened to traffic by King Albert on Sept. 10. The ceremony included the decoration of two of the American engineers who participated in the design and construction of the tunnels. Both tunnels were built to open up the west bank of the river to development. Descriptions of them were published in *Engineering News-Record* June 29, 1933, p. 827. The vehicle tunnel follows American practice both in its general form and in the method of construction, as will be seen from the accompanying illustration (left). Its general character was first proposed by American engineers and they participated in the design and in the supervision of construction. The tunnel is 5,800 ft. long. Its shield driven section has an exterior diameter of 30 ft. and a roadway width of 22 ft., somewhat wider than the roadway in the Holland tunnel in New York. The pedestrian tunnel has an interior diameter of 14 ft. 9 in., and a walk 12 ft. 6 in. wide. Its total length is 1,750 ft. between the elevator and escalator shafts at the ends.

At the opening ceremony, King Albert conferred the rank of Officer of the Crown of Belgium upon Ole Singstad, consulting engineer, New York, and upon Walter J. Douglas, New York, of the firm of Parsons, Klapp, Brinckerhoff & Douglas, New York, who with Mr. Singstad acted as consultants to the firm of Pieux Franki, contractors for the entire work. Other American engineers who assisted in the work included S. A. Thoresen, F. W. Barnes and Harry Talbot. Cornelius F. Cahalane, tunnel traffic consultant, New York, also was decorated by the King.

II.

Globe Photos



PWA Housing Loans Promised to Cleveland and Five Other Cities

APPROVAL of a loan of $12,000,000 for low-cost slum-clearance housing in Cleveland was announced by the Public Works Administration on Sept. 7. The loan is contingent upon the organization in Cleveland of a single limited-dividend corporation (under the auspices of the Mayor's Business Recovery Commission) to handle the three separate projects that the loan covers and also upon the furnishing of $2,000,000 of equity money. Any less amount of equity, it is understood, will be matched by a loan in the same ratio. The projects covered include portions of projects previously submitted to PWA by Cleveland Homes, Inc., Community Homes Co., and Forest City Housing Foundation. The first of the three projects is sponsored by Benedict Crowell, Newton D. Baker and Walter R. McCornack, architect. The second and third projects are sponsored by Joseph L. Weinberg and Conrad & Teare, architects.

It is understood that arrangements have been worked out whereby Cleveland Homes, Inc., will become the parent corporation, enlarging its directorate to include a fair representation for the sponsors and architects of the other two projects.

The areas in which these projects will be erected have been selected on the basis of data assembled by the City Plan Commission, the sub-committee on housing of the Mayor's Business Recovery Commission, Ernest J. Bohn, chairman, and Howard W. Green, consultant to the housing division of PWA. At the time the loan applications were filed the locations of the projects were as follows: Project 1—Cedar to Central Ave., S.E., between E. 22nd and E. 35th Sts.; Project 2—Washington and Main Aves., N.W., Mulberry Ave. on the east, W. 29th St. on the west and River Ave., N.W. on the north; Project 3—Central to Scovill Ave., S.E. from E. 22nd to E. 30th Sts.

The housing to be constructed will rent at an average of between $8.00 and $8.50 per room per month. The projects provide for two- and three-story apartments, two-story fireproof row flats and row houses. The areas to be cleared are 33.7, 61 and 19.5 acres respectively, near the center of the slum district of Cleveland.

Tentative approval of a loan of $1,000,000 in Euclid, Ohio, a suburb of Cleveland and $500,000 in St. Louis for low cost housing was announced at the same time as the Cleveland loan. Also on Sept. 12 the board authorized loans of $4,460,000 for construction of 200 houses in Indianapolis; $2,965,000 for 31 separate apartment house units known as Hallets Cove Garden Homes, Inc., in Queens Borough, N. Y. City; $5,184,000 for the Hillside Housing Corp. project in the Bronx, N. Y. City and $168,000 for several apartment house units in Raleigh, N. C.

The Euclid loan will be made to the Euclid Housing Corporation, a nonprofit corporation, to be formed by a group of leading citizens headed by Mayor C. R. Ely. The project calls for the building of 300 houses in groups of not less than 50, convenient to transportation and industry. The lots are owned free and clear by different individuals who will turn their titles in clear of incumbrance to the housing corporation. The loans made to the property owners will be amortized over a period of 20 years by payments of $30 to $40 per house per month. The housing will consist of one or two-story brick or frame houses on lots of an average of not less than 50 ft. frontage.

The proposed project in St. Louis will be built by a limited dividend corporation, composed of a responsible group of St. Louis citizens, and sponsored by the Neighborhood Association which already has control of the land required and is prepared to make an investment of $100,000 in addition to the Government loan. The project covers a site 272x407-ft. located in the north-central part of the city in a densely populated slum area a half mile from the center of the city. It is planned to build three-story fire-proof apartments, containing 252 apartments with a total of 641 rooms, in units of from two to four rooms. If the loan is made at 4 per cent and 1.35 per cent amortization, the rents will average $9.67 per room per month. Work can be begun within 60 days.

These recent loan approvals, together with a $45,000 housing allotment to the Virgin Islands, bring the total housing loans to $35,942,000. Previous loans have covered five projects.

Housing to be pushed

In a statement last week, Harold L. Ickes, Public Works Administrator, indicated a determination on the part of PWA to assist low-cost housing. "The provision of good low cost housing," he said, "and the clearing of slums create the best kind of jobs. Either or both are as constructive a type of public works as can be undertaken. In the permanent economic reconstruction that will follow the present emergency, the reform of our housing on a tremendous scale must take first place. Common sense dictates that we seize the opportunity offered by the emergency to begin it now." Referring to the opposition of private enterprise to government-financed housing, Secretary Ickes said, "None stands to gain more from public works loans for such projects than the building and real estate interests themselves, for unless jobs are found for tenants, rent and property values cannot be maintained even at their present levels. Good housing raises and protects all adjoining property values."

Housing policy

Robert D. Kohn, director of the housing division of PWA, in a recent statement, pointed out that the value of land that will be considered will be based on its reasonably anticipated earnings when used for low-cost housing and not upon its speculative value. Projects will be favored that represent a low ratio of land cost to the cost of labor and materials. Projects contemplating construction of low buildings are particularly invited, but apartment houses of 6, 7 or 8 stories will receive loans if the work is ready to go ahead immediately and aid re-employment. Housing upon which loans will be granted should be of the simplest design possible and yet contain all facilities necessary to encourage a better standard of living. Fireproof construction is preferred, and to encourage it loans are offered at amortization rates of 1.35 per cent as compared to 2.4 per cent for ordinary construction.

Ohio PWA Engineer Approves Aid for Cleveland Sewage Plant

L. A. Boulay, engineer for the Oh Public Works Advisory Committee, h recommended that the PWA grant a lo of $6,498,000 and a grant of $2,492,000 f construction of the Cleveland sewage trea ment plant. Also included in his recon mendation was one for an allotment $650,000 for Cleveland parks.

Eleven projects in all were recommende by Mr. Boulay, including five in Cincinnati, one in Clark County, one in Springfield, and one in Freemont.

◆

PWA Loan for Power Development Asked by East Bay District

Application for an $8,500,000 PWA loan has been made by the East Bay Municipal Utility District, Calif., to (1) develop fully the power resources of this water-supply system and (2) improve existing mains and filter plant facilities. The plan for power development would include a new dam and power house at Middlebar on the Mokelumne River with an additional increase in the capacity of the present plant at Pardee dam, a transmission line to Oakland and a steam standby plant for a total estimated cost of $6,500,000. The improvement to the water supply system provides for increasing the capacity of the Orinda filtration plant and replacement and extension of existing mains for a total cost of $2,000,000.

The additional power output, according to report, would exceed the pumping requirements of the district and would be available for sale in the East Bay area, now served by the Pacific Gas and Electric Co. which already has a large power surplus.

◆

Los Angeles County to Sue San Gabriel Dam Contractors

The Los Angeles, Calif., county grand jury on Sept. 6 adopted a resolution ordering the county counsel to prepare a civil suit against the contractors involved in the San Gabriel high dam case and against E. C. Eaton, county flood control engineer. The civil action, if prepared on the lines suggested by the grand jury, will name the firms of Fisher-Ross-MacDonald & Kahn, contractors; MacDonald & Kahn, Inc., and MacDonald & Kahn, Ltd., and Alan MacDonald, Felix Kahn, Charles R. Ross, Claude Fisher, Sidney T. Graves and Mr. Eaton, personally. The suit will seek judgment for $830,765.90, a sum paid to the contractors by Los Angeles county in settlement of their claims for damages for failure of the county to complete its contract, and $1,846,166.79 which was paid the contractors for excavation work at the rate of $2.95 a cubic yard. The resolution accuses Mr. Eaton of knowingly permitting the contractors to proceed in a manner contrary to accepted engineering practices, particularly in the use of explosives in excavating for the proposesd dam, construction of which was abandoned because the site of the dam was faulty. Mr. Graves is a former member of the county board of supervisors. He recently was convicted of accepting an $80,000 bribe for his aid in effecting the county settlement with the contractors, and is now awaiting decision on his appeal.

St. Louis Epidemic Cited In Plea for Sewerage System

Referring to the epidemic of sleeping sickness now current in the region of St. Louis, the County Court of St. Louis County has sent a letter to Governor Park, of Missouri, requesting that in his call for a special session of the General Assembly he include a clause which will authorize passage of sewer legislation for St. Louis county. The letter points out that the population of the county has increased 100 per cent in the last ten years, with the greater part of the increase being in eighteen municipalities adjacent to the St. Louis city limits. The population of the county at present is given as 235,000.

The letter states, in part: "As a result of inadequate sewage disposal, we are forced to face the fact that our people are oonfronted with a dangerous situation. We are blighted with the worst epidemic of contagious disease we have ever experienced. We are convinced that whatever might be the source of this disease, this condition could not have come about if adequate provision for sanitation were provided. Some new legislation which will enable us to bring about a remedy is absolutely necessary."

◆

Allotments from PWA Fund Near Half-Way Mark

(Continued from page 330)

for the work already have been received and contracts will be let soon after the state and Administrator Ickes sign a contract. One bridge will be across the Bellamy River and the other across Little Bay. These structures will become links in the state and federal highway systems. The Little Bay bridge, the larger of the two structures, will be a high level bridge about 1,528 ft. in length, consisting of nine steel truss spans supported upon masonry piers. The Bellamy River crossing will be a low level reinforced-concrete structure, 600 ft. long, supported on piles, and will include a steel draw span.

A grant of $34,800 was made to Salem, Mass., to be used for a street-construction program. In this case, also, no borrowing is to be done from the public works fund.

Construction on 74 Indian irrigation projects in nine states has been allotted $6,164,050 from the public works fund. In many instances Congress had already appropriated the money to carry on the construction but the funds were later impounded in anticipation of PWA allotments.

An allotment of $1,531,945, of which $1,000,170 is for new construction and $214,700 for reconditioning, has been made to the Coast Guard.

The National Parks, Buildings and Reservations Commission has been made an allotment of $2,279,474 for construction and physical improvements in a number of states. Of this amount $1,059,450 will go for roads and trails in national parks and $895,000 will be used for physical improvements of other nature. Repairing and reconditioning public buildings in the District of Columbia accounts for $261,925.

For 22 public buildings outside of the District of Columbia, to be erected under the supervision of the Treasury Department, the PWA has allotted $2,273,671.

Washington Notes

By Paul Wooton
Washington Correspondent

Secretary Ickes' statement putting the responsibility for delay of the public works program on the "dilatory tactics" of states and cities has caused considerable resentment. So much so that Henry M. Waite, Deputy Administrator, went on a tour of the country this week to drum up projects. Required to comply with elaborate procedure that has been set up for the handling of projects, local bodies point out that they are expected to act instanter, while the PWA in Washington has consumed 3 months in setting up its organization.

The decision of the Ickes' board to make tentative allotments on a prima facie showing that a project is desirable has somewhat quickened the flow of proposed projects through the state organizations to Washington but it will probably be impossible for many towns to prepare a complete presentation of their case within the 30-day period following the board's tentative action. It is understood, however, that this period will be extended in extenuating circumstances.

Review board named

Appointment of a technical board of review to consider particularly difficult or controversial projects and to hear appeals is another step forward in completing the PWA organization. The review board will consider projects adversely reported by state boards or the staff in Washington which, in the opinion of Deputy Administrator Waite, warrant review; projects protested by outside parties when such protests are regarded as serious by Col. Waite; and projects approved in principle by Col. Waite which are of unusual size or character involving questions of engineering, finance or law that, in his opinion, warrant collective consideration. Carey H. Brown, director of the Rochester, N. Y., Civic Improvement Association, is acting chairman of the board of 12 engineers, which will serve on a per diem basis.

Municipal projects approved

The first battalion of local projects forced their way through the PWA organization this week—eleven small waterworks and sewerage projects, two bridges and one street program, for which allotments by PWA total $3,619,180. On three projects, PWA made a grant only, as the applicants were able to cover the remainder of the cost without borrowing from the federal government. The First Taxing District of Norwalk, Conn., obtained a 30 per cent grant of $75,000 for waterworks. Without the grant the project probably would not have been undertaken at this time. St. Paul, Minn., will get a 30 per cent grant of $87,180 on a program of street improvements. The state of New Hampshire obtained a 20 per. cent grant of $230,000 for two bridges.

The procedure and forms required by PWA with reference to local proposals present a sharp contrast to the free hand with which millions have been allotted for federal projects on which engineering studies have not been completed. Many towns, forced to retain consulting engineers, enter into criticism that is not mollified by comment at PWA that the projects which have been presented in good shape and are going through fast are those which have been prepared by consultants. Cities seeking legal advice with reference to their authority to participate in the public works program will receive assistance from the American Municipal Association.

Air trip itinerary

Col. Waite is accompanied on his 6,000-mile air tour by Henry T. Hunt, general counsel, Lewis P. Mansfield, director of the finance division, and Aubrey E. Taylor, of the public relations division of PWA, in order that field forces may be informed on all aspects of the preparation of project proposals. Secretary Ickes stated that the purpose of the trip of the PWA officials is to bring more understanding to the country of that organization and the requirements that must be met in forwarding projects to Washington for approval. Meetings will be held with regional advisers, state advisory boards and state engineers. The itinerary is as follows: Sept. 13, New York; Sept. 14, Boston; Sept. 15, Chicago and Kansas City; Sept. 16, Cheyenne; Sept. 17, Salt Lake City; Sept 18, Amarillo; Sept. 19, Forth Worth; Sept. 20, Atlanta; Sept. 21, Washington, D. C.

Northern work favored

In order to push the public works program forward as fast as possible before winter sets in, right of way has been given to projects in northern states. The PWA will encourage advertisement for bids as soon after tentative allotments are made as the specifications can be completed in order to eliminate the lag. Both Secretary Ickes and Col. Waite are confident that local practice with reference to the award of contracts can be limbered up and the construction program carried right through the winter in many communities.

◆

Tropical Hurricane in Texas Causes Great Damage

A tropical hurricane of great intensity struck Brownsville, Texas, and the lower Rio Grande Valley on the night of Sept. 4, severing all communication between that area and the rest of the state. About 22 people were killed, hundreds were treated for injuries and more than 2,000 families were homeless in the Brownsville, San Benito and Harlingen areas.

In the region covered by the hurricane hundreds of light structures were blown down, as were huge trees and poles carrying public utility wires. Tidewater blown in from the Gulf of Mexico covered the streets several feet deep in most of the towns in this area.

◆

Hackensack Valley Sewerage Board Starts Official Existence

Administering of the oath of office to the four commissioners on Sept. 7 officially brought into being the Hackensack Valley Sewerage Authority. The commission was recently created by the New Jersey state legislature to design, build and supervise a trunk sewer for 57 municipalities in Bergen and Hudson Counties.

The commissioners are Thomas J. Wasser, county engineer of Hudson; Joseph Kinzley of Teaneck, Frank B. Chapman of Jersey City, and James A. Breslin of Lyndhurst. They are to serve one, two, three and four years, respectively.

Construction Codes Considered by NRA

(Continued from page 330)

Various proposals as to wage rates were proposed to be substituted for the provision in the code that "employers in the construction industry shall pay wages not less than the minimum rate of wages for unskilled labor hereby established, which shall be not less than 40 cents per hour, unless the hourly rate for the same class of work on July 15, 1929, was less than 40 cents per hour, in which case the hourly rate shall not be less than that of July 15, 1929, and no others less than 30 cents per hour."

Higher rates proposed

M. J. McDonough, head of the building trades department of the American Federation of Labor, summed up the views of labor in relation to the construction industry in a two-hour speech. He took special exception to the fact that the code sets minimum wages only for unskilled labor (other than for accounting and clerical help), principally upon the ground that unskilled labor made up only 16 per cent of the total, whereas skilled labor was about 67 per cent. He proposed, along with the 30-hour week, that the minimum wage for skilled and unskilled labor be the same as the rate prescribed by the Public Works Administration for projects financed under the Recovery Act (*ENR*, Aug. 24, p. 238), namely, Southern zone, skilled labor, $1; unskilled labor, 40 cents; Central zone, skilled labor, $1.10; unskilled, 45 cents; Northern zone, skilled labor, $1.20; unskilled labor, 50 cents. To these rates he added minimum rates for semi-skilled labor at 65 cents, 75 and 85 cents for the three zones respectively. Mr. McDonough further proposed that in the establishment of these rates the existing differential between the various classes of labor be maintained and that rates for piece work be made comparable with the hourly rate.

For accounting and other clerical help, Mr. McDonough proposed weekly rates of $15, $15.50 and $16 for the three zones. He proposed doubling the hourly rate for all extra work or work on Saturdays and legal holidays.

Economies expected

Answering the claim made subsequently by representatives of real estate interests that the higher wages for laborers would so increase building costs as to put a check upon all private construction, Mr. McDonough stated that as the direct labor cost of building construction was about 25 per cent of the total, an increase of 40 per cent in labor rates would only increase the cost of a building 10 per cent, and that as the code then under consideration was expected to eliminate many of the wasteful practices of the industry, there should be no increase in the total cost because of the indirect economies obtained thereby.

Labor provisions defended

Representatives of the Construction League defended the omission of minimum wages for skilled labor on the ground that skilled wage rates are set by a multitude of local agreements and that it would be highly undesirable to upset such agreements by attempting to set minimum skilled rates for the industry generally, or even regionally, as has been done by the PWA.

Bidding procedure

Material changes were proposed by the Construction League in the section of the code relating to bid peddling. When the code was drafted, it included only a broad general statement against the practice of bid peddling and a statement that the supplemental codes should each make specific provisions to eliminate this practice. In the revision now proposed to the NRA, bid peddling is defined in more detail and specifically prohibited. Fifteen paragraphs relating to bidding practices are added. This change was made because the diversity that has developed in the section relating to bidding practices in the supplemental codes so far submitted to the code committee of the Construction League, has made it impractical to attempt to adjust their differences by revisions in each code.

Registration of contracts

The Construction League, in a recommended addition to the Code, proposes that the construction industry make provision for the registration of all construction contracts and works projects, and for the collection and collation of facts and data in regard to the industry and for an equitable apportionment and distribution of costs.

General contractors code

At the opening of the hearing on the general contractors code, the code was formally presented by A. C. Tozzer for the Associated General Contractors of America, representing 4,700 firms doing general contracting work. He was followed by A. P. Greensfelder, who presented a survey on the magnitude of general construction operations throughout the country and a statement on the function of the general contractor for the information of the NRA.

Data on wage scales and related matter in support of the wage and hour provisions of the general contractors code were presented by T. S. Holden, representing the committee on working conditions of the Construction League, of which John W. Taussig is chairman. The committee's study of the wage scales actually paid on 60 post office jobs indicates that a large majority of them are under the scale as set by the PWA for operations it finances. The scale set by the state highway department for similarly financed work also is below the PWA scale, and 80 per cent of the scales paid by contractors on current work are below the PWA scale, according to the committee.

Representatives of organized labor appeared to request that the same suggestions as to hours and wages as were made at the hearing on the general code be considered as applying to the general contractors code.

Changes in the labor provisions of the code to conform with the changes proposed in the construction industry code were submitted to the PWA by the Construction League. There also were submitted proposals for numerous minor changes that require entire rewriting of several of the articles.

The American Institute of Steel Construction and others objected to the wording of the section relating to payment. As written, it abridges the rights of the subcontractor by permitting the general contractor to postpone payment of a subcontractor until he has been paid by the owner.

Building trades employers

O. W. Rosenthal, president of the National Building Trades Employers Association, objected strongly to the evident intent of the Construction League to bring the contractors represented by the Building Trades Employers associations under the general contractors code along with the contractors on general engineering work. He stated that their association together with the National Builders Exchange submitted a code covering building work in the larger centers of population and asked Deputy Administrator Malcolm Pirnie to

Stephen F. Voorhees (left center), chairman of the code committee of the Construction League of the United States, as he presented the code for the construction industry to the Administrator of NRA on Sept. 6. At Mr. Voorhees' left are John P. Hogan, vice chairman, Willard T. Chevalier and A. E. Horst, of the code committee. The other members of the committee are F. P. Byington, P. W. Donoghue, C. H. Dabelstein, William Steele, 3rd, and J. W. Follin, secretary.

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look into reasons for this code not having been put forward for consideration as one of the supplementary codes. He made a strong plea that it be so included. Mr. Rosenthal opposed the inclusion in the general contractors' code of any provision that would eliminate the machinery now in existence for adjusting all labor difficulties between the employers' associations and the labor unions in the building field and Mr. Rosenthal objected to writing any labor rates into the general code that would have the effect of abrogating existing wage agreements on building work in the large centers, or would permit contractors not members of their association to enter into competition with them by paying the lower rates established in the general contractors' code.

Separate building code proposed

A proposal for a building construction code largely independent of the general contractors' code, made by Mr. Rosenthal was supported by Mr. McDonough, of the American Federation of Labor. He questioned the need of the general contractors' code and recommended to the administrator that instead there should be separate codes for building construction, highway construction, railroad construction, etc., coming directly under the basic code for the construction industry. He questioned the need for a general contractors' code.

Architects' code

The architects' code was the third of the construction codes to be considered. It was presented by W. S. Parker, chairman of the code committee of the American Institute of Architects, who also proposed several changes in the code as submitted to the administrator on Aug. 25. These included a new definition of the term "architect," an increase in the work week from 35 to 40 hours, increase in the limitation on the monthly work from 150 to 170 hours, and the entire elimination of the sections on bidding procedure to conform with the changes proposed in the basic code for the industry.

The definition, from the point of view of the engineer, is the most significant change proposed in the code. It was developed as the result of continued negotiations between the architects' and the engineers' code committees. The new definition is as follows:

> The term "architect" as used herein is defined to mean any person who holds himself out as able to perform or who does perform any professional service such as consultation, investigation, evaluation, planning, design, including aesthetic and structural design, or responsible supervision of construction, in connection with any private or public buildings, structures or projects, or the equipment or utilities thereof, or the accessories thereto, wherein the safeguarding of life, health or property is concerned or involved, when such professional service requires the application of the art and science of construction based upon the principles of mathematics, esthetics and the physical sciences. It is recognized that the function of an engineer include elements of a like nature to the elements included in the architect's functions. Such normal functions as practiced by engineers shall not be deemed to be included in the foregoing statement of the functions of an architect. Such normal functions of an engineer being excluded, any one performing any of the above defined services or undertaking to provide and to be responsible for such services shall be deemed an architect for the purposes of this code and he shall be qualified by education, experience, and organization to perform properly the services which his employment demands.

Opposition to the hour and wage provisions of the code was expressed by representatives of the sub-professional group, including the International Federation of Technical Engineers and the Federation of Architects, Engineers, Chemists and Technicians. A. P. Greensfelder, representing the Associated General Contractors of America, made comment on details of the code, especially the need for amplification of the section relating to relations with contractors.

Engineers' code

Hearings on the engineers' code have not yet been scheduled. The code as submitted to the Administrator (*ENR*, Sept. 7, p. 290) was given a pre-view by the staff of NRA on Sept. 1, and on Sept. 8, following the hearings on the code already presented and further discussion with the architects' code committee, it was resubmitted for public hearing in the form embodying the changes recommended by the administrator's staff and those developing as the result of the hearings on the other codes.

Most of the changes from the code as published in *Engineering News-Record* last week are minor. In Article II, the definition of what constitutes active practice and responsible charge of engineering as given in the constitution of the American Society of Civil Engineers, was added at the request of the legal department of NRA, and the latter part of the definition of the functions of a professional engineer was modified to make it parallel with that in the latter part of the definition of an architect. Definitions of "person" and of "employee" were added and the reference to the Am.Soc.C.E. code of ethics in Article IV was deleted, also upon instructions from the legal department of the NRA, because its phraseology is not adapted to being written into law directly.

In Article V, the following was added to correspond with a like clause in the architects' code: "If the character of the work requires architectural or other specialized services not included in the functions of an engineer, as herteofore defined, it is the engineer's duty to recommend specialists for employment by or on behalf of the owner and to coordinate their work."

The section on bidding practices was eliminated entirely from the latter part of Article VII, as that subject is covered in the basic code as revised.

Article VIII, administration, was revised to provide that the American Society of Civil Engineers always have a majority of three members of the national control committee. This was done upon instructions from the legal department of the NRA as the NRA will look to the American Society of Civil Engineers as the controlling body under the code.

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Labor Advisor on NRA Codes Named for Construction Industry

Michael J. McDonough, president of the building trades department of the American Federation of Labor has been named labor advisor for the codes of the construction industry by Leo Wolman, chairman of the labor advisory board of the NRA. Mr. McDonough will be assisted by the following men on the subcodes: General contractors' code, John P. Coyne, international representative, International Union of Operating Engineers; Architects' code, C. L. Rosemund, president, International Federation of Technical Engineers and Draftsmen.

Bids Asked for on 30 Miles of Lake Okeechobee Levees

The U. S. Engineer office at Jacksonville is asking for bids on 30 miles of combined levee and navigation channel construction around the east and south shores of Lake Okeechobee. The channel will follow the shore line of the lake, embankment for the levee coming from the channel excavation. Bids for the first section, 14 miles long, along the south shore will be opened Sept. 25. Principal quantities involved are: embankment, 10,220,300 cu.yd.; waste excavation, 2,470,000 cu.yd.; riprap, 122,900 cu.yd. Proposals for the second section, along the east shore, will be opened Oct. 2. Quantities are: embankment, 13,340,840 cu.yd. of sand and marl; 1,454,080 cu.yd. rock fill; waste excavation, 1,964,000 cu.yd.; riprap, 131,700 cu.yd., estimated on basis of hydraulic dredging, with some changes of quantities expected if draglines are used.

◆

Radio Telephones to Direct Work on San Francisco Bridge

High-frequency radio telephones have been installed at headquarters, field offices and boats on the San Francisco-Oakland bridge work to improve communication facilities over the scattered operations now starting on the project. Both the engineering organization and the two foundation contractors on the main channel work will make use of the system. The radio phones will eliminate countless trips by messengers on boats to inaccessible pier locations and are estimated to effect direct saving in time as well as provide closer contact in the working organizations.

The engineers will have stations at the main office, the resident engineer's field offices and on the five boats used on the job. The Transbay Construction Co. will have stations at their main office, the pier locations and boats. Bridge Builders, Inc., will also connect their headquarters, field offices and work boats.

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SOCIETY CALENDAR

AMERICAN ASSOCIATION OF ENGINEERS, annual meeting, Chicago, Ill., Oct. 3-6, 1933.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Milwaukee, Wis., Oct. 9-11.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual meeting, Chicago, Oct. 17-21.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, Indianapolis, Ind., Oct. 9-12.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Milwaukee, Wis., Sept. 25-27.

AMERICAN WELDING SOCIETY, fall meeting, Detroit, Mich., Oct. 2-6.

HIGHWAY RESEARCH BOARD, National Research Council, Washington, D. C., Dec. 7-8.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, annual meeting, Milwaukee, Wis., Sept. 21-23.

INTERNATIONAL CITY MANAGERS ASSOCIATION, annual conference, International House, Chicago, Sept. 18-20.

NATIONAL SAFETY COUNCIL, 22nd Annual Safety Congress, Chicago, Oct. 2-6.

NATIONAL ASSOCIATION OF RAILWAY AND UTILITIES COMMISSIONERS, annual meeting, Cincinnati, Ohio, Oct. 10-12.

NEW ENGLAND WATER WORKS ASSOCIATION, annual convention, Bridgeport, Conn., Sept. 19-22.

Obituary

Harry Lanon, of Susquehanna, N. Y., a member of the engineering staff of the Erie Railroad, was killed in the railroad wreck near Binghamton, N. Y., on Sept. 5.

Alexander Diven, manager of the Engineering Societies Building in New York City, took his own life on Sept. 9. Mr. Diven had been in charge of the Engineering Societies Building since 1921.

Raymond J. Smith, assistant chief engineer of the maintenance bureau of the State Highway Department of Ohio, died at his home in Columbus on Aug. 21. Mr. Smith was formerly county surveyor of Champaign County and entered the service of the State Highway Department in 1923.

George S. Meredith, building contractor of Milwaukee, Wis., took his own life on Sept. 1. He was 62 years old. Mr. Meredith was president of Meredith Bros. Co., which has erected many large industrial and other buildings in Milwaukee and the vicinity.

Lloyd F. Layne, pump manufacturer of Memphis, Tenn., died in that city on Sept. 7 at the age of 41. He was president of Layne & Bowler, Inc., and Layne Central Co., and of the subsidiaries of these firms located in a number of cities. He was a native of North Dakota, but had resided in Memphis since 1917.

J. Parker Snow, consulting engineer of Boston, Mass., died at his home in Somerville, on Sept. 4. Mr. Snow graduated from Dartmouth College in 1875. For several years he was instructor in civil engineering at Dartmouth, later becoming bridge engineer and then chief engineer of the Boston & Maine Railroad. He had been in consulting practice since 1911.

Robert Maitland Hannaford, Montreal engineer, died in that city on Aug. 28. Mr. Hannaford began his engineering career as rodman on the Montreal and Champlain Junction survey in 1882, joining the Phoenix Bridge Co. at Phoenixville, Que., in 1886 as a draftsman. The following year he became a division engineer on the Grand Trunk Railway. In 1924 he joined the Montreal Tramways Co. as assistant chief engineer in charge of maintenance of ways and structures, which position he held at the time of his death.

Carroll C. O'Neill, consulting engineer, died at his home in Brookline, Mass., on Sept. 10. He was 43 years old. Mr. O'Neill was graduated from the engineering school at Tufts College in 1914 and subsequently attended the Lawrence Scientific School of Harvard University. After leaving college he was at various times superintendent of the Beatty Construction Co., chief consulting engineer of the Commonwealth Engineering Corp., chief engineer of the Aberthaw Construction Co., and, at his death, consulting engineer of Wilson & Co., of Chicago, and the Perrin-Walsh Co. of Cambridge, Mass.

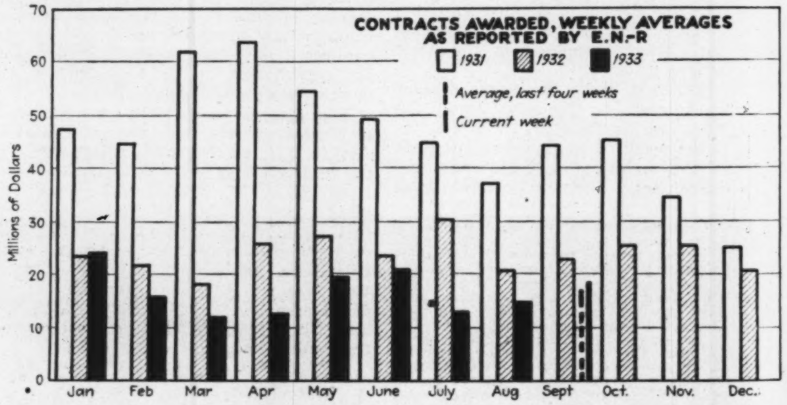
George Clinton Ward, president of the Southern California Edison Co. died in a hospital at Los Angeles on Sept. 11. Death was caused by complication of ailments aggravated by heart disease. Mr. Ward was 70 years old. Mr. Ward's first engineering position was with the Mohawk Division of the West Shore & Buffalo Railroad, now a part of the New York Central system. In 1897 he became assistant engineer for New York State canals, and later, resigning that office became associated with the Furnaceville Iron Co., at Utica, N. Y. In 1902 he went to Washington Court House, Ohio, to modernize the city's water supply and left in 1905 to become assistant general manager of the Huntington Land & Improvement Co., at Los Angeles, Calif. In 1911 he became vice-president of the Pacific Light & Power Co., and joined the executive staff of the Southern California Edison Co. in 1917. He was appointed to the presidency on Oct. 18, 1932.

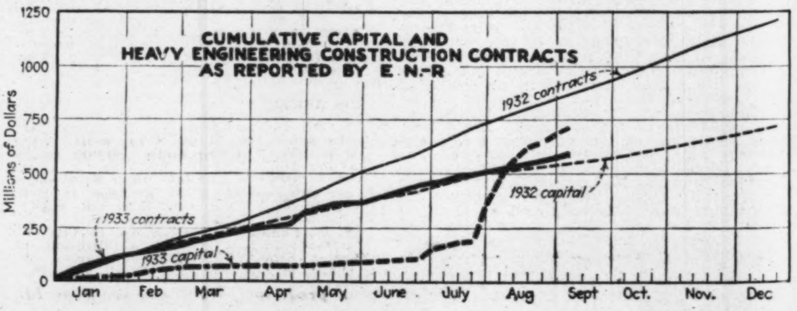
Engineering Contracts and Capital

Highway contracts let last week reached the highest mark of the year, $10,440,000, and pushed the total of all contracts reported for the week to $20,586,000, a considerable increase over the previous week's total of $14,197,000. Private contract awards, amounting to $5,159,000, were helped by several distillery contracts, one at Peoria, Ill., to cost $1,550,000. These are the first distillery contracts reported in years. Public works awards totaled $13,470,000, of which $2,272,000 was for federal work. A U. S. Marine hospital contract at Stapleton, N. Y., $1,957,000, raised federal awards to $2,272,000, the highest since last April. New York state led the highway lettings last week with awards aggregating $2,484,000. Most states now have their federal aid highway programs under way.

Cumulative contracts let to date this year are far behind last year's total to date, the figures being $604,844,000 and $868,898,000, respectively. The average of contracts let the last four weeks is $17,464,000, as compared with a weekly average of $22,897,000 for September, 1932.

New productive capital figures reported for the week total $18,931,000, of which $1,677,000 represents public bond sales and the remainder federal loans and grants to states and municipalities for public works. Appropriations for strictly federal projects, made under the public works act, are not included in our new capital totals. No private financing was reported.





Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Sept., 1932	Average Four Weeks	Week Sept. 14, 1933
Federal Government..	$4,670	$1,395	$2,272
State and municipal..	15,464	10,497	13,155
Total public.......	$20,134	$11,892	$15,427
Total private......	2,763	5,572	5,159
Week's total.......	$22,897	$17,464	$20,586
Cumulative to date:			
1932..............		$868,898	
1933..............		604,844	

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Sept., 1932	Average Four Weeks	Week Sept. 14, 1933
New capital issues....	$3,750	$36,408	$18,931
Cumulative to date:			
1932..............		$525,100	
1933..............		717,471	

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ENR Cost and Volume Index

E.N.R.-Cost		E.N.-R. Volume	
September, 1933	**175.48**	**August, 1933....**	**73**
August, 1933.....	167.00	July, 1933........	65
September, 1932..	157.96	August, 1932.....	111
1932 (Average)...	156.97	1932 (Average)...	127
1931 (Average)...	181.35	1931 (Average)...	220
1930 (Average)...	202.35	1930 (Average)...	260
1913 (Average)..............	100		